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MAJOR INTERNATIONAL R & D RANGES AND TEST FACILITIES

SUMMARY OF CAPABILITIES

1990

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UNITED STATES ARMY

TEST AND EVALUATION COMMAND

93-13568

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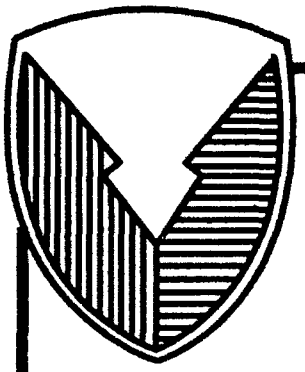

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SUMMARY OF CAPABILITIES

1990

UNITED STATES ARMY

TEST AND EVALUATION COMMAND

FOREWORD

International Agreements and Memoranda of Understanding encourage joint development and use of military systems by Allied Nations. To meet allied objectives; knowledge of and confidence in test and evaluation concepts, capabilities and practices within each Nation's defense structure should expedite development, testing, acceptance and deployment of joint and national systems.

The purpose of this document is to provide a brief description of the organization, management and capabilities of major test activities supporting the Defense Departments of Canada, France, the Federal Republic of Germany, the United Kingdom and the United States. This first edition of an international summary of R&D Ranges and Facilities is a condensation of the information available at publication.

National organizations for management of military system acquisition are evolving to accommodate changing requirements and the impact of new technologies. Changes, additions and recommendations should be sent via channels to the following:

Commander
U.S. Army Test and Evaluation Command
Attn: AMSTE-TC
Aberdeen Proving Ground, Maryland 21005-5055

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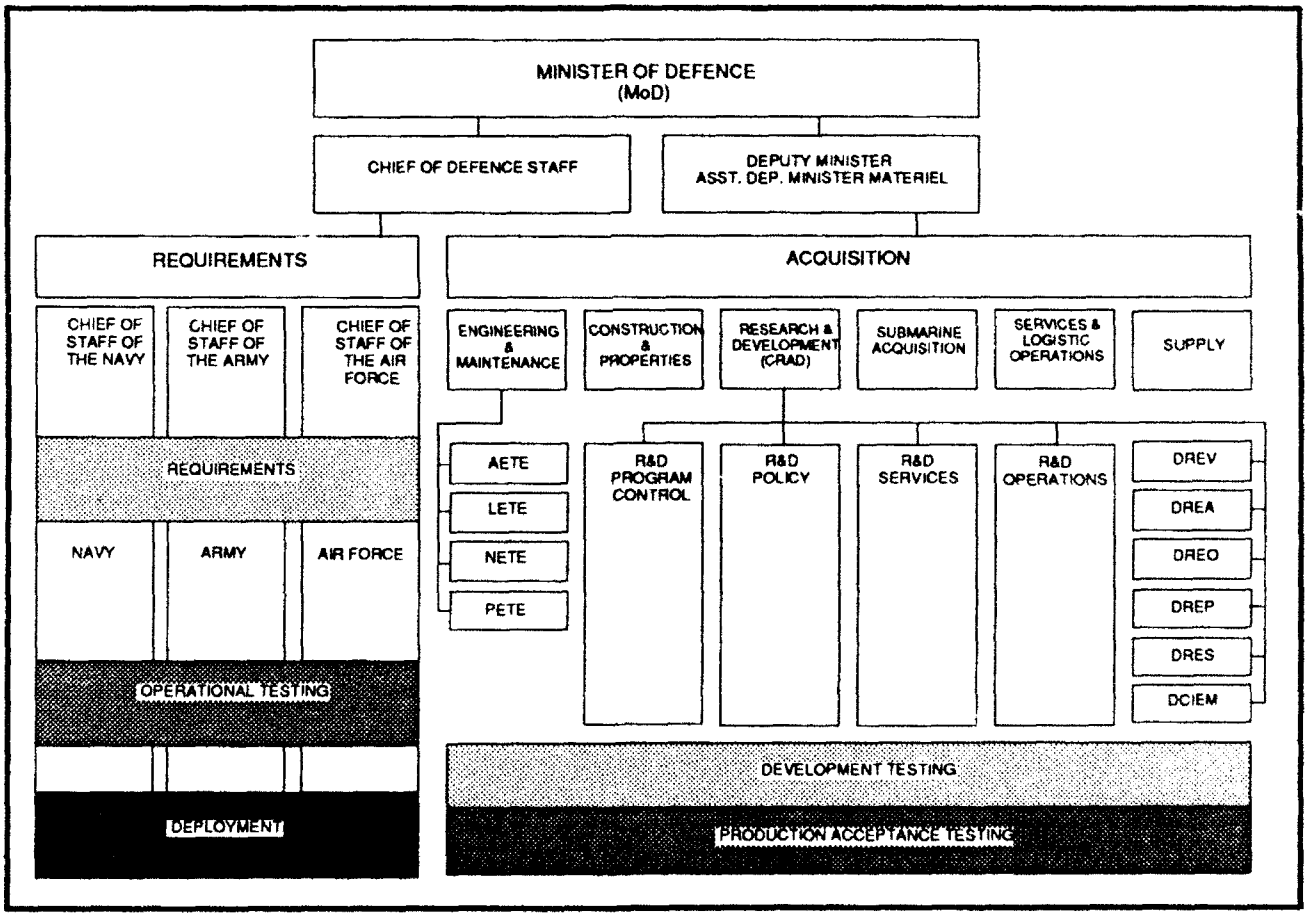
CANADA

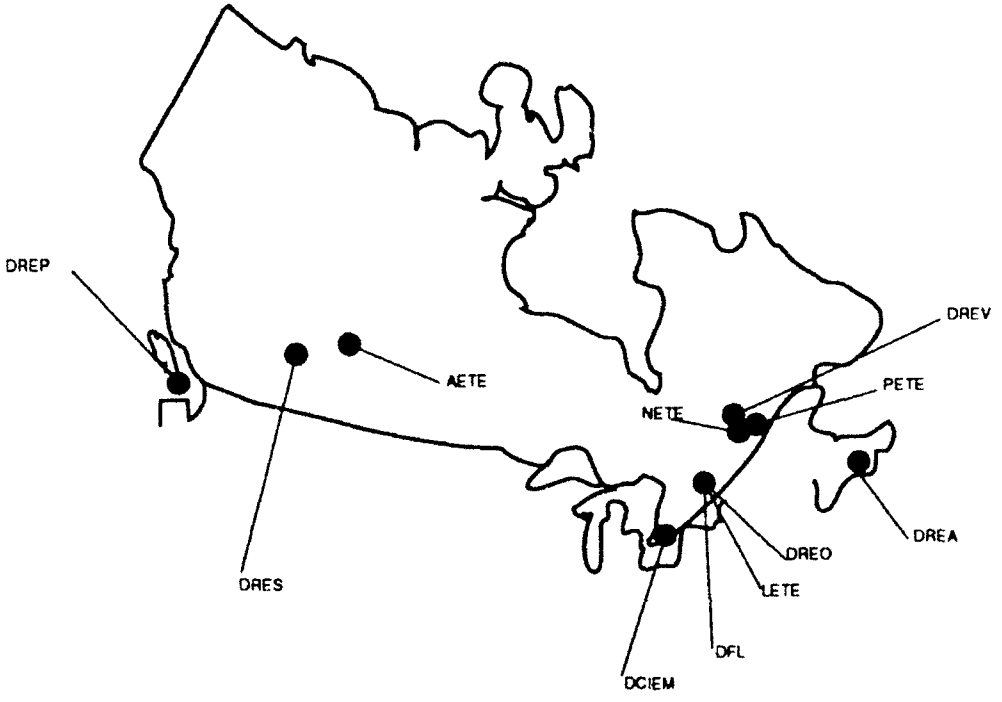
CANADA

The Chief of Defense Staff provides operational requirements information to the Minister of Defense and the Deputy Minister. The Assistant Deputy Minister for Material (ADM/MAT) is responsible for the acquisition functions including research development, testing and evaluation. The Chief Research and Development (CRAD) provides the sciences and Technologies for R&D and the Chief Engineering and Maintenance (CEM) performs the design and development testing of military systems.The various branches of the Canadian Combined Forces provide operational requirements information, oversee the operational testing of systems and direct deployment of the military forces. The figure below illustrates the Department of National Defense (DND) Organization for T&E functions.



Canadian DND Functional Relationships

CANADA



RESEARCH & DEVELOPMENT (CRAD)

The Defense Research Establishment Valcartier (DREV)
The Defense Research Establishment Atlantic (DREA)
The Defense Research Establishment Ottawa (DREO)
The Defense Research Establishment Pacific (DREP)
The Defense Research Establishment Suffield (DRES)
The Defense and Civil Institute of Environmental Medicine (DCIEM)
David Florida Laboratory (DFL)

ENGINEERING & MAINTENANCE

Aerospace Engineering Test Establishment (AETE)
Land Engineering Test Establishment (LETE)
Naval Engineering Test Establishment (NETE)
Proofing Experiment Test Establishment (PETE)

Canadian DND R&D Facilities
Location of Activities

AEROSPACE ENGINEERING TEST ESTABLISHMENT (AETE)

MISSION

Provide aerospace flight test services, flight test expertise, and general engineering services for the Canadian Forces.

LOCATION

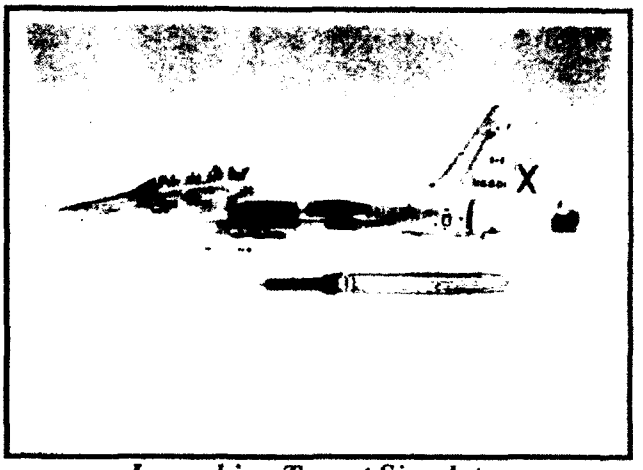
AETE, a lodger unit at CFB Cold Lake, Northeastern Alberta, is the Flight Test Authority for the Canadian Forces and is directly responsible to National Defence Headquarters/Assistant Deputy Minister Materiel (NDHQ/ADM (Mat)). It is functionally controlled by the Director General Aerospace Engineering and Maintenance (DGAEM).

CAPABILITIES

Topography: Flat northern prairie and bog land.

Functions: To fulfill its role within DND, AETE is divided into five branches: Flight Test Operations, Test Engineering, Data Engineering, Aircraft Maintenance, and Administration.

Flight Test Operations consists of five sections. Of the 27 personnel in the branch, 16 are Qualified Test Pilots (QTPs), graduates of the Empire Test Pilot School, the USN Test Pilot School, the USAF Test Pilot School or the Ecole du Personnel Navigant D'essais Et De Reception. Helicopter Flight Test and Aircraft Flight Test are responsible for flight testing all rotary wing aircraft and fixed wing aircraft (excluding CT-18) respectively. CF-18 Flight Test conducts all CF-18 flight testing. Systems Flight Test, with four navigators and one pilot, all graduates of the Aerospace Systems course, test and evaluate aerospace avionics systems, electronic warfare hardware and software, IR systems, etc. The Test and Acceptance Standards Officer is responsible for flight test standards and acceptance testing of all aircraft and flight simulators delivered to the Canadian Forces, with detachments at contractor's facilities, as required. Air Operations provides support or flight test operations and is responsible for aircrew training and standards.



Launching Target Simulator

The specific tasks within this role are many and varied but include:

Planning, coordinating, executing and reporting on the appropriate phases of Category I, Category II, and Ship-Aircraft Compatibility flight testing of all new aircraft and flight simulators, and determination of the operating envelope of matched ship-aircraft systems.

Assisting and advising operational commands, as required, in the conduct of Category III flight testing - Service Operational Trials.

Conducting flight evaluation and other flight test programs, including technical flight trials in the operating environment when required, for aircraft systems and ship-aircraft systems which have undergone a model change or a major modification having, or likely to have, an effect on the operating characteristics or limitations of the system.

Preparing Aircraft Operating Instructions (AOI) amendments and Modification Leaflets from data accumulated in conjunction with each new aircraft evaluation and test program or with any other evaluation program.

Designing, developing, testing, technically evaluating,

and reporting on new aircraft devices, materials, systems, and modifications.

Conducting and coordinating the testing for acceptance at contractor's premises of all Canadian Forces aircraft, operational flight trainers and flight tactical trainers following production, repair, overhaul, modification or unit installation.

Providing assistance to the Director of Flight Safety (DFS) by:

- investigating unsafe or unusual performance factors or flying characteristics which may arise in any aircraft in service, and
- providing specialized engineering services for accident investigation purposes.

Conducting preliminary flying and technical evaluations of proposed new aircraft (including fixed wing, rotary wing, and V/STOL) and other aerospace equipment being considered for purchase by the Canadian Forces.

Specifying the standards and methods to be followed by service and civilian agencies in the conduct of flight testing (including experimental flight testing) of aircraft by or on behalf of the Canadian Forces, and monitoring and inspecting the application of these standards.

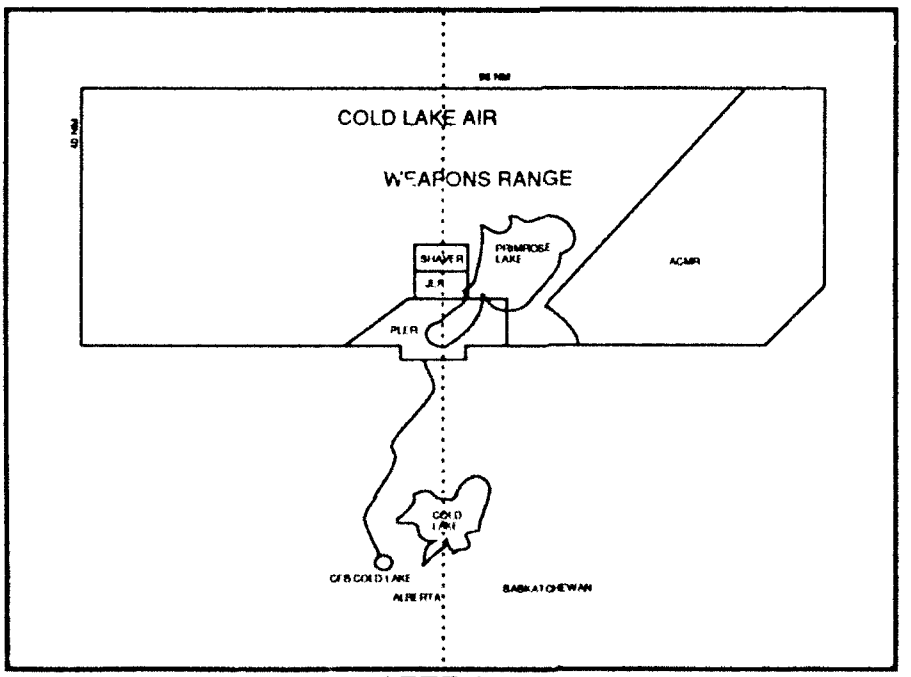
Ranges:

Numerous ranges accommodate the test activities of AETE at the Cold Lake Air Weapons Range (CLAWR).

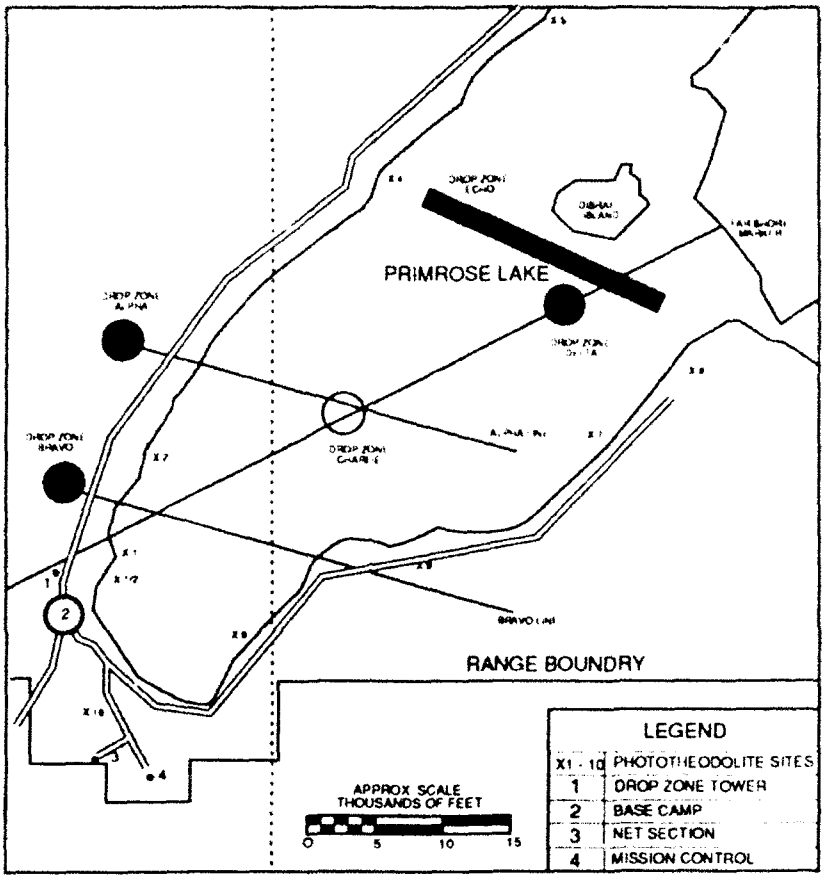
The CLAWR is a rectangular area, 98 nm long by 40 nm wide, with its southern border 22 nm north of CTB Cold Lake. Much of this terrain consists of muskeg, with numerous streams, lakes and sloughs. The range is rough and densely wooded in many parts, and the only means of reliable entry by vehicle is over an all weather road to the south end of Primrose Lake. Four specialized ranges are encompassed by CLAWR; the Shaver River Range, used for high explosive ordnance; the Jimmy Lake Range (JLR), a standard controlled range for training in the use of bombs, rockets and guns; the Air Combat Maneuvering Range (ACMR), and PLER. PLER is located on the southern boundary of the CLAWR and is used exclusively by AETE for test and evaluation purposes. Instrumentation, control and support facilities are available for conducting a wide variety of trials. The Base Camp is the terminal point of the 30-mile road from CFB Cold Lake, and is the domestic center of the PLER. Roads from the Base Camp provide access to all range sites. The following facilities are provided:

- Messing. A maximum of 125 servings per meal may be prepared in the kitchen facilities. The dining room can accommodate 80 personnel at a sitting.

- Accommodations. Two barrack blocks can provide sleeping quarters for approximately 40 personnel but they are not normally used full time except for a small number of base support personnel required to maintain security and other related support during quiet hours. For normal operations all personnel are bussed to PLER each morning, except on weekends, from CFB Cold Lake and returned at the end of work hours.



AETE Area



Primrose Lake Target Area

- Transportation. Tracked and wheeled vehicles for normal range duties and for specialized support of projects are established at the Base Camp. Additional vehicles may be supplied from CFB Cold Lake. A limited quantity of gasoline and diesel fuel is stored on site.

- Marine. Project support on the lake surface is supplied by one 36-foot crash boat equipped with two-way radio communications on UHF and FM. The Marine Section has two 16 ft boats and a 15 ft by 45 ft barge mounted with a 5,000 lb capacity power crane. A maintenance building and dock are also provided for the Marine Section.

- Power. Normal range power is supplied from the commercial grid in Alberta.

- Fire Fighting. A fire truck equipped to deliver water, foam, and fog is established at Base Camp. Portable fire fighting equipment is also available.

- Security. PLER is a restricted area. Vehicle traffic entering or leaving the range is controlled by security personnel at the entrance to the Base Camp.

PLER is a designated low flying area and depending on the requirements of each project and test sortie the entire CLAWR airspace, or a portion thereof, may be used for AETE tests. PLER airspace extends from the ground to unlimited altitude tests.

The operation and control of PLER is the responsibility of the CO, AETE. His delegated representative, the Officer Commanding PLER (OC PLER), exercises control of all range missions and test procedures.

POINT OF CONTACT

Director, Aerospace Engineering Test Establishment (AETE)
Canadian Forces Base Cold Lake
Alberta, CANADA

Telephone: (403) 8606

CANADA

LAND ENGINEERING TEST ESTABLISHMENT (LETE)

MISSION

Provide fourth line automotive, communications, electronics and armament engineering services and conduct test and evaluations of specified military equipments as directed.

LOCATION

LETE is a lodger unit of CFB Ottawa.

CAPABILITIES

Topography: The Proving Grounds are comprised of 176 hectares (436 acres) of hills, swamps, wooded areas, open fields, sand and exposed bedrock, all of which provide an excellent variety of terrain for mobility type testing. These features, together with several kilometers of hard surface straight and oval courses (asphalt over concrete), secondary type roads (with dirt and gravel surfaces) concrete and grass slopes to a maximum gradient of 50%, make it possible to carry out a large variety of engineering tests.

Functions: The special functions of LETE as directed by NDHQ are:

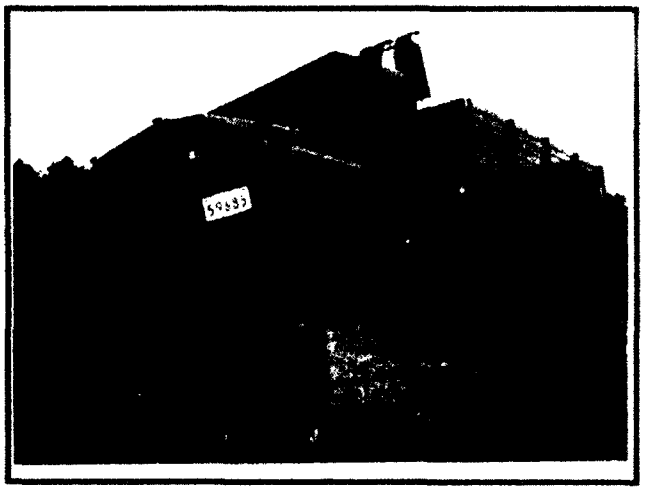
The performance and reporting of engineering tests and evaluations of army equipment, airfield support equipment, and certain electrical and electronic equipment associated with maritime and ground-based aerospace support system.

The study and verification of new ideas and concepts.

The investigation of failures and malfunctions of in-service equipment.

The design and production (from block communication system concepts) of circuits, assemblies, electronic packages, interfaces and minor equipment, including associated technical information for data packages as required.

To design and fabricate tactical vehicle kits from stated requirements and produce technical data packages as required.



A 2 1/2 Ton MLVW Demonstrates the Effects of the Frame Twister

To produce as directed limited numbers of equipment where military in-house or industrial manufacture is not feasible, practical or economical.

To demonstrate or display equipment, components or materiel.

To obtain equipment, components or materiel for tests, evaluations and technical studies. This may include fabrication in LETE workshops, purchase or rental by Standard Loan Agreement, or demand from service supply sources.

To control and provide accountability for equipment, components or materiel during the course of development projects.

To maintain special electronic equipment for the army until normal repair depots are trained and equipped for servicing the same.

To provide facilities and services for other government departments and civilian agencies as directed.

Develop, repair and overhaul specifications as required by NDHQ.

Produce and maintain initial spares, schedules, provi-

sion scales, supply spare scales, and overhaul spare parts scales for land technical equipment.

Develop standard repair times, maintenance techniques, permissive repair schedules, special tooling and test equipment and produce draft instructions implementing these developments on land technical equipment and other equipment as directed by NDHQ/DGLEM.

Facilities: A Fording/Swim Tank is available and is used to evaluate the fording capability of various vehicles and to provide a brake immersion area prior to wet brake performance tests. Limited floating and swimming tests can also be carried out in this tank. Prepared courses of Belgian Pave, Granite Blocks and Concrete Sinewave provide a facility for testing vehicle suspension and track systems, and for conducting shock and vibration tests. A Bridging Test Device, adjustable in four- inch increments, allows determination of the size of free gap which can be traversed by any vehicle. A concrete stepped ramp is available for static frame twisting tests. Special articulation gauges are used to provide various inputs to vehicle suspension systems, and a concrete Standard Trench obstacle provides a quick assessment of approach and departure capabilities. One ramp of this trench is designed to simulate the loading ramp of a C-130 Hercules. A vertical wall obstacle is available for heights of 30 cm (12 in.) to 105 cm (42 in.) in 5 cm (2 in.) increments.

Indoor facilities include a hydraulically operated 55 ton capacity tilt table used to conduct tests related to vehicle lateral stability, systems operations, and overflow limits of integral liquid containers and reservoirs. A 224 KW (300 hp) engine dynamometer, a chassis dynamometer, a winch test device and a generator load bank are available through the Mechanical Lab, and are more fully described later.

Also available is a powerful Intergraph Interpro 32C engineering work station with computer assisted design (CAD), solids modeling, animation and simulation modeling capabilities. A number of IBM PCs further compliment the capability of the Test and Evaluation Division. Other tests which may be conducted by the Test and Evaluation Division include cold climate environmental tests of vehicles and components, rail and air transportability, human engineering and safety, and durability and reliability.

The Automotive Support Section Workshop encompasses 21 work bay stations, an engine rebuild room, a paint booth, a battery charging room, tire repair facilities, a vehicle wash bay, a complete lubrication facility plus a well equipped tool crib. Space is also allocated to house electrical test equipment capable of diagnosing engine and power train problems. The workshop floor area is equipped with a floor hoist capable of lifting 16 tons, an 18 ton overhead crane, a 32 ton weigh scale, and a portable Washtronics hoist capable of lifting 6 tons. The workshop is manned by fifteen military and civilian vehicle technicians under the supervision of the Production Warrant Officer.

A Measurement System Division is located at the Orleans Site and is comprised of the Instrumentation Section, Mechanical Laboratory and the Photographic Section. Its function is to support automotive and mechanical tests by providing data acquisition and reduction, special mechanical test facilities and to provide Unit photographic services ranging from still photography to high speed cinematography. Engineering and photographic data are provided to LETE Tasking Officers for use in the preparation of engineering reports.

Communications Engineering provides a broad range of design and development, test and evaluation, fault investigation and analysis tasks on communication equipment and systems. Work is done for all four operational CF Commands, with the prime area of work being on radio and antenna systems. The laboratory includes an extensive array of sophisticated manual and computer controlled test equipment to conduct these functions.

The section is equipped with state-of-the-art automated test measurement equipment and computer design and simulation systems, a PC based electronic circuit schematic capture and printed-circuit-board layout system (PCAD) and an electronic simulation system (PSpice). A computer controlled network analyzer is available for the analysis of radio and antenna systems over a frequency range of 0.5 MHz to 1.3 GHz. The section is moving into surface mount technology (SMT) to further miniaturize its designs. Designs developed here are prototyped by the Engineering Support Division.

Electronics Engineering provides a broad range of design, development, evaluation failure investigation and analysis tasks on digital and analogue equipment and systems. Capabilities include the design and development of hardware and software for microprocessor based equipment, audio equipment, motor control applications, control systems, training devices, test instruments and data communications. The section is also responsible for telephone and signaling applications including voice companding, analogue and digital filter design.

Communication Electronics System Evaluation and Test employs standard electronics test equipment as well as specialized manual and automated test equipment for conducting electromagnetic compatibility and interference (EMI and EMC) testing of vehicle electrical and generator systems. Testing is done on an automated test system, covering the

range of 150 KHz to 1.2 GHz. The testing can be done at LETE or on site, transported in a special air transportable van equipped with the facilities to provide stand alone operation.

The Electro-Optical Engineering Section is equipped with test equipment for the manual and automatic measurement of electro-optical parameters, and has access to several controlled light level laboratories in the unit. Equipment is available for the measurement of the optical, signal and modulation transfer functions; the various characteristics of lasers such as beam diameter, divergence and pulse width and power; focal length, collimation, magnification, gain and field of view; and a forward looking infrared measurement system.

Armament Engineering accomplishes test, evaluation and modification of land force weapons ranging from pistols to main battle tanks and self-propelled howitzers. The all military section is concerned with the operation of the weapon system, not the effect of the round. This section has a new 100- meter Indoor Engineering Test and Experimental Range which permits the firing of weapons of up to 40 millimetre cannon from either a fixed or vehicle mount. All firing is done under computer control permitting exact test repeatability and the rapid collection and reduction of data. The range instrumentation measures the projectile speed and flight path; in order to determine the effects on the weapon's operation caused by wear, etc. All tests may be video taped from a variety of angles with a rapid shutter speed camera system to provide stop action pictures or by high speed film or video done by LETE's photographic section to provide a detailed time picture of the weapon operation.

Small arms weapons are fired from either a fixed precision "Guilda" mount which permits single shot to rapid fire with the weapon returning to the same point of aim between shots or a soft recoil non-precision endurance mount to permit the firing of large numbers of rounds by a weapon in order to produce accelerated wear. Provision is included in the building for a fixed cannon mount which will be designed to meet the parameters of the individual weapon. Cannons of 25, 30, 35 and 40 millimetres may be fired safely, using training practice or training practice tracer ammunition. The range butts consist of 12 meters of sand, one inch of armour plate and 18 inches of concrete set into a limestone hillside. Additional armour plate is installed in the cannon bay butts. The building includes environmental cleaning equipment to remove and safely dispose of all lead and other dangerous fumes.

Weapons of larger calibers must be fired off site, at either CFBs Petawawa or Gagetown. Recent work done off site has included the design and proof firing of new vehicle mounts for the TOW missile system and the adaptation of an Austrian mount to the CFF 106 millimetre recoilless rifle. Work at the indoor range has included the preproduction testing of the SARP family of weapons, the selection trial of various pistols for a pistol replacement project, the design of various modifications to a Norwegian TOW Under Armour vehicle to meet Canadian specifications and the testing to destruction of various weapons with barrel obstructions.

The Environmental Test Section performs a variety of environmental tests on items to ensure that they meet Military Standard 810C or 810D. It is equipped to duplicate most shock, vibration, bounce, temperature, pressure and humidity conditions that an item would meet in operational circumstances in any of the Forces operational commands. All instruments can provide printed readouts of test conditions. The destination vehicle for the item under test can be instrumented in the field and the data recorded, so that the vibration profile that the unit is tested under is exactly the same as the end environment. The section is primarily intended for testing LETE designs but does test for outside agencies when directed.

Section equipment includes the following:

A three axes electro-dynamic vibration table under computer control for sine wave, random and shock testing, operating from 5 Hz to 5 KHz with a maximum 3,000 pound force and one inch displacement.

A single axis hydraulic vibration table under computer control for sine wave, random and shock testing, operating from 0 to 500 Hz with a maximum 22,000 pound force and a 10-inch displacement.

An impulse shock machine with a maximum impulse of 1500 G and a maximum test item weight of 200 pounds.

A transportation simulator machine with three motions (orbital, out- of- phase orbital and vertical) and a maximum test item weight of 1,000 pounds.

Various sized temperature chambers, from small to walk- in chambers, operating over a maximum range of -73 degrees to 160 degrees Celsius.

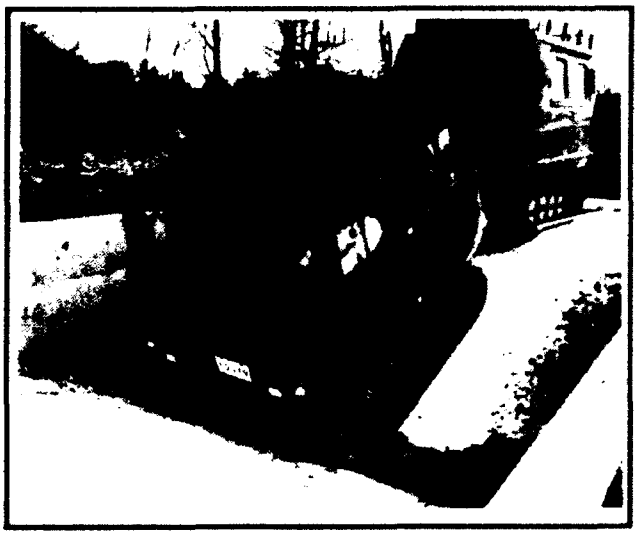
An altitude chamber operating over a wide temperature range to a maximum simulated altitude of 100,000 feet above sea level.

Humidity chambers with varying temperature ranges, operating from 20% to 98% relative humidity.

NATO standard drop test machine.

POINT OF CONTACT

Chief
Land Engineering Test Establishment
Ottawa, Canada



BV206 Entering the Standard Trench

An M11SA1 Traveling the Sinewave Course

CANADA

NAVAL ENGINEERING TEST ESTABLISHMENT (NETE)

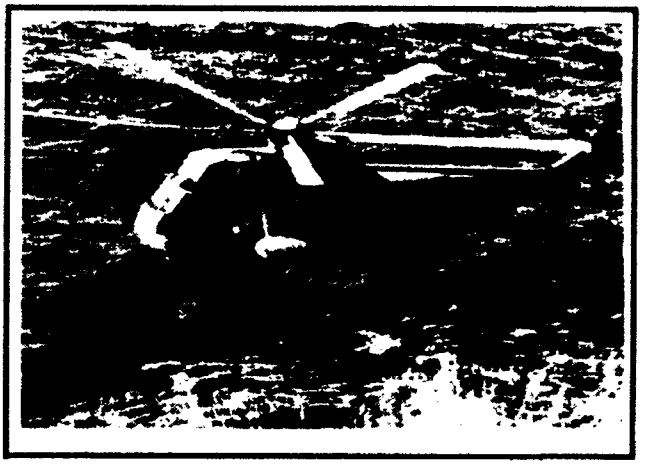
MISSION

Provide fourth line engineering and field testing services, in support of naval equipment, to the Canadian Forces.

LOCATION

NETE is located in the industrial community of Ville LaSalle, Quebec which is approximately 15 km west of downtown Montreal.

Located 35 km N-W of St. Hubert military base, 5 km S-E of Dorval airport or 50 km S-W of Mirabel airport, Ville LaSalle is readily accessible from Ottawa or any other major city in the world.



Careful Study is Needed to Select the Right Equipment for the SEA KING Replacement Helicopter

CAPABILITIES

Topography: Located on approximately 96,000 sq. ft. of land, NETE comprises one main building with numerous annexes that provide 44,800 sq. ft. of floor space of which 23,000 sq. ft. is allocated to test facilities and the balance to support services.

Functions:

Production testing of systems and equipment to assure their compliance with the specified service requirement.

Identifying design deficiencies which may adversely affect systems and equipment performance in service, providing engineering, manufacturing and evaluated corrective measures.

Technical evaluation of selected proprietary systems, equipment, techniques and processes to determine their compliance and suitability for the current and future needs of the CF; and , the provision of consultation services to improve specified operational requirements.

Technical evaluation and testing of prototype systems, equipment and instrumentation related to the marine environment.

Calibration services of a nature and quality that will provide effective and economical support to in-house and field work related to NETE.

Provision of services related to vibration and shock standards.

In-house and field in-line measurements of noise, vibration, temperature, shock, pressure, stresses, flow, etc., of CF systems and equipment.

In-house and field testing of manufacturers' sample systems and equipment submitted for CF approval and qualifications.

Design studies, research and development projects related to the improvement and monitoring of the maintenance requirements and performance of selected CF systems and equipment.

Developing and evaluating data reduction, retrieval and analysis computer programs and equipment for the purpose of improving the control and application of equipment and

system with regard to NETE projects.

Provision of related engineering, advisory and facility services to Canadian industry (on a charge for actual costs incurred bases) when it is in the national interest and not commercially available as interpreted by ADM(Mat).

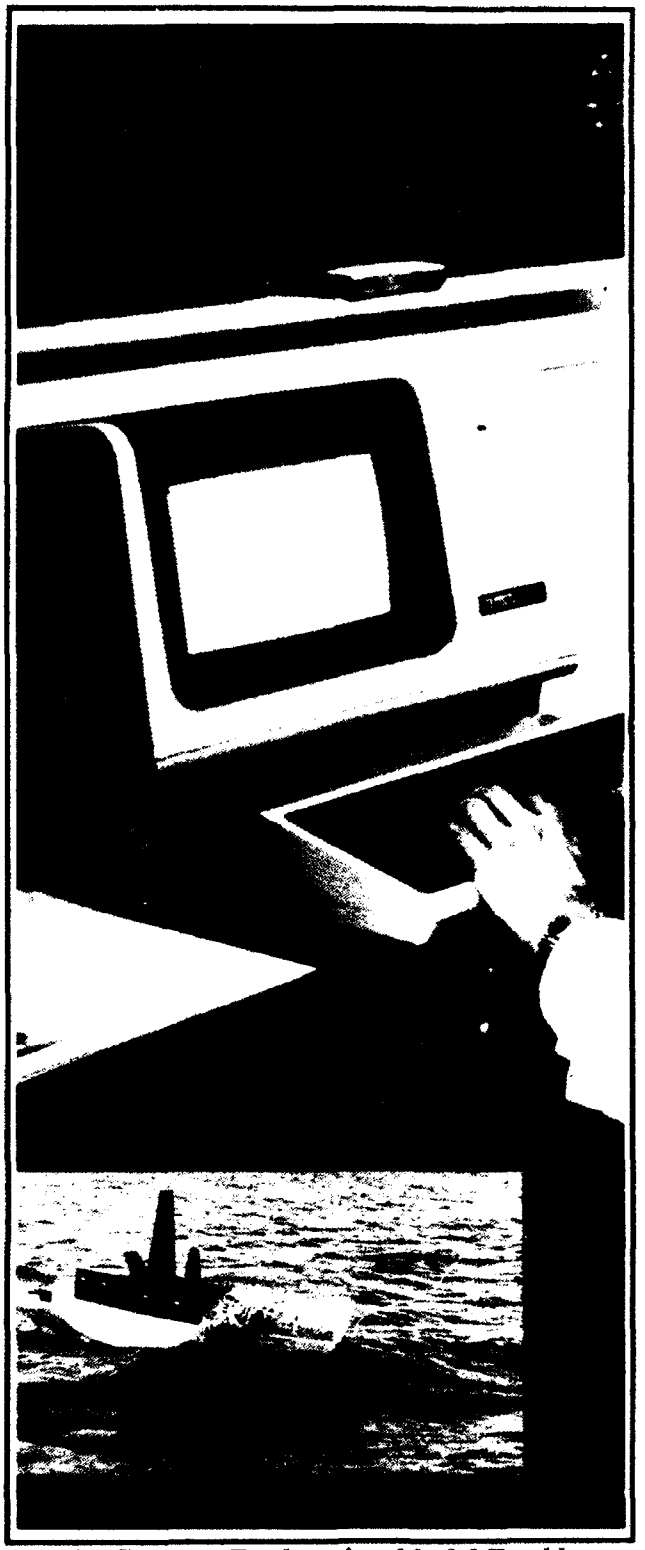
Provision of services to other DND and government agencies as directed by ADM(Mat).

Facilities: A broad spectrum of support test facilities and instrumentation and technical services is available at NETE to satisfy the needs for investigational, qualification, developmental and production testing of single or multiple apparatus systems for the marine environment. These include:

- Electric Motor Test Capability
- Rotational Speed Calibration
- Temperature Indication, Recording and Control
- Pressure Indication, Recording and Control
- Humidity Indication, Recording and Control
- Flow Indication, Control and Recording
- Electrical Calibration Service
- Torque Measuring System
- Strain Gauge Measurements
- Speed Measuring and Control
- Force and Load Indication, Recording and Control
- Vibration Calibration Service
- Mechanical Division
- Shock Test Facilities
- Vibration Facility
- Temperature/Humidity Chambers
- Oscillating Tables
- Salt Fog and Rain Chamber

POINT OF CONTACT

Chief,
Naval Engineering Test Establishment
Ville La Salle, Quebec



The Concept Exploration Model Enables Quick-Looks at Many Ship Design Variants

CANADA

PROOFING EXPERIMENT TEST ESTABLISHMENT (PETE)

MISSION

Support the Canadian Forces by providing engineering and quality assurance services to Design Authorities, Quality Assurance staffs and Canadian Manufacturers.

LOCATION

Three kilometers west of the town of Nicolet, Quebec, on the southeastern shore of Lake St. Pierre.

CAPABILITIES

Topography: A 20 square kilometer strip of land, extending from the Nicolet River about halfway along the shore of Lake St. Pierre. A rectangular shaped 22 x 6.5 kilometer impact area is contained in the southern half of the lake.

Functions: Nine particular functions evolve from the mission.

Development and maintenance of appropriate test facilities in relation to present and future munitions test commitments.

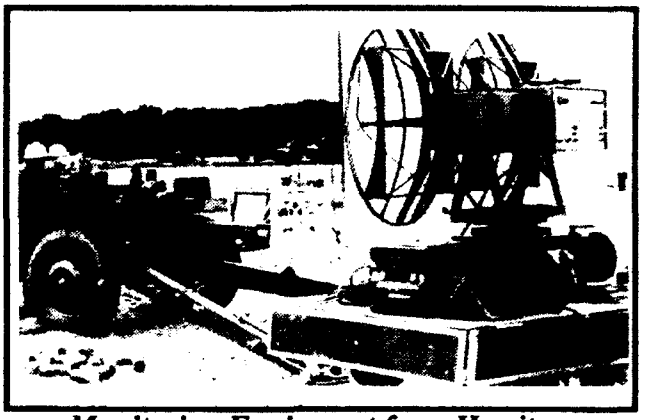
Proof (contract acceptance tests) of Canadian manufactured ammunition and weapons except those items for which the contractor has approved test facilities.

Tests commissioned by contractors, to verify processes or otherwise facilitate manufacture.

Tests to establish serviceability of stocks.

Tests commissioned by Quality Assurance or Design Authorities to verify performance or investigate malfunctions.

Tests commissioned by Design Agencies in support of development programs except tests executed by Defence Research Establishment, Valcartier (DREV) using domestic resources.



Monitoring Equipment for a Howitzer

Tests on behalf of agencies outside DND, i.e., US Army, Ordnance Board, etc.

Provision of facilities and resources to DREV.

Establishment and maintenance of liaison with international and national technical agencies and the provision of representation on committees dealing with munition testing.

Facilities/Resources:

NATO National Test Agency. This facility which has no permanent staff is collocated with the PETE underground small arms test range in an old storage area underneath the armament section complex. Personnel and resources are supplied on request by PETE and for the duration of tests are considered to be a part of the NNTA.

Resource Management Group. The Resource Management Group at PETE is responsible for financial management, planning of equipment and material requirements, personnel training, information security and general security, administration of civilian personnel of PETE, and records management.

Informatics Section. The Informatics Section (PETE) is composed of four computer specialists, three of whom are programmers. This section is primarily responsible for the acquisition, programming and maintenance of software, and also provides assistance to users.

Closed Vessel Testing. PETE regularly conducts closed-vessel tests on propellant powder. Essentially, these tests consist of setting fire to samples of powder in a closed vessel and using electronic equipment to determined the characteristics of each type of powder.

The Armament Group. The Armament Group is very unique and its title does not clearly define all of the functions that it performs. The sections are structured to:

- provide and maintain weapons for all tests;
- manufacture test rigs, parts and pieces that cannot be obtained through local channels nor purchased outside DND;
- provide a technical labour pool that serves the weapons and test rigs; and
- provide the manpower required for foam test and cleaning of the firing batteries.

Ammunition Section. As set out in the manuals on explosives safety and handling, the role of the Ammunition Section is to supply the components of cartridges to be tested, such as projectiles, cases, primers, fuses and standard propellant powders. Reception, assembly and conditioning of ordnance are other duties related to this role.

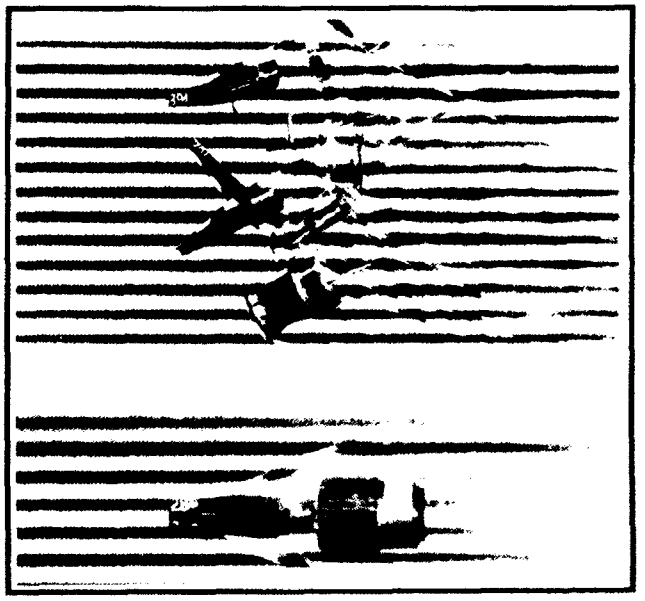
Instrumentation Section. The structure of this section is based on two categories of services; one involved in testing and the other in support. Testing services include the acquisition and processing of data from computerized electronic systems used especially in tests and experiments on weapons and ammunition of all kinds. Support includes maintenance and use of communication systems and of the closed-circuit audio-visual system; as well as meteorological services, including radiosondes, sonometry and laboratory equipment.

Photography Section. The role of the Photography Section of PETE is to provide photographic documentation on testing. With advanced equipment, we can study the behavior of projectiles in flight, check that munitions components are functioning correctly and analyze movement in weapons.

POINT OF CONTACT

Mr. J. P. Bouvette
Superintendant,
Proof and Experimental Test Establishment
Nicolet, Quebec

Life Cycle Material Testing



The SMEAR Synchronized Ballistics Camera

CANADA

DEFENSE RESEARCH ESTABLISHMENT VALCARTIER (DREV)

MISSION

Chief Scientific consultants to the Department of National Defense (DND). Provide and manage a national program of defence research and development and scientific consultative services that will provide effective and timely support to the Canadian Forces and the Department, both now and in the future.

LOCATION

Valcartier, Quebec, near Canadian Forces Base, Valcartier.

CAPABILITIES

Topography: The site on which DREV is located was first developed as an artillery and small arms proof establishment at the beginning of World War II. This same site was where the Internal Ballistics Research Laboratory, which conducted studies for the National Research Council, was opened in January 1943.

Functions: Defence Research Establishment Valcartier (DREV) at Valcartier, Quebec, is DND's largest research and development laboratory and also the largest bilingual research centre of the Federal government. The establishment's role is linked closely with the Canadian Forces. Seventeen Canadian Forces personnel are integrated within the DREV research program and work with the civilian staff. Together they carry out a wide range of activities including research, development, evaluation, and various equipment and system studies. The scope of the establishment's activities covers ordnance including rockets, propellants, launchers, guns, projectiles and guided weapons, explosives, pyrotechnics, and operational equipment; electro-optical systems such as visible and infrared sensing devices and lasers; and automatic data processing applied to command and control.

The R&D program is national in scope and activity. Its participants include science-based departments and agencies, e.g., Department of Communications, National Research Council, and industrial firms and universities from coast to coast. The scientific and technical staff and the facilities of the DREs are Canada's main assets in defence science and technology and carry out the Department's in-house defence research and development.

Howitzers, Guns, Mountings and Vehicles Under Study

The R&D program is broadly based and multidisciplinary and involves two related types of activity. One type maintains and develops expertise in the defence sciences and technologies and is commonly referred to as Technology Base activity. It is carried out in industry and universities by means of research contracts, in other departments on a cost-recoverable basis and in the DREs as a major part of their work.

The Technology Base activities cover a wide range of technologies needed to support the acquisition of modern and effective military systems and to contribute to the survival and effective performance of military personnel. The defence Technology Base is developed in the DND DREs, universities, industry, and other government laboratories.

A high percentage of the effort is devoted to technologies which support detection and surveillance, communications,

and command and control. The technologies include radar, electro-optics, underwater acoustics, space-based systems, electronics and advanced computer-based information management and decision support techniques. There is also significant effort concentrated on technologies aimed at promoting survival of military personnel and their systems in the complex electronic environment encountered in potential conflicts. Activities aimed at providing a physical capability in conflicts include technologies in ordnance, energetic materials, hydronautics, energy conversion and conservation, materials services, mobility, countermobility, aeronautics, combat engineering, and human protection and performance.

Technology Applications, the second major activity in the R&D program, consist of projects funded by CRAD Headquarters for the acquisition of new or improved military systems, equipment and components through new development, modifications to existing operational systems, or offshore purchase of systems. Most projects involve expert consulting or direct development support from the DREs. Each major acquisition calls upon a variety of technologies and R&D-performing organizations. All fields involve the industrial sector and all depend upon scientific and technological participation by government R&D organizations, the principal ones being the DND DREs and the Communications Research Center of the Department of Communications. The Technology Applications work in the departmental R&D elements normally consists of tasks undertaken by CRAD establishments in response to requests from within the Department for the application of science and technology to specific operational and equipment questions.

Typical Projects Supported:

Data Processing in Command and Control, Simulation and Image Processing. Over the past few years, part of DREV's research has focussed on the application of computer techniques to weapons and military tactics. The rapid progress made recently in the field of high-speed microcomputers and programming has led to many new applications which have until now been considered impossible because of the volume of equipment and other complex software involved.

It is by keeping abreast of the latest developments in these sciences that the establishment is able to adapt and apply them to the current and foreseeable needs of the Canadian Forces. The three main projects being worked are the development of data processing facilities for handling tactical land data, a computer simulation system designed for antisubmarine warfare, and the digital processing of images.

Ballistic Instrumentation and Metrology. The development of ordnance inevitably involves field or laboratory experiments to validate the performance predicted from theoretical models. These experiments, which are often unique and highly specialized in nature, require state-of-the-art facilities and instruments. Very often the scientists must themselves design new measurement systems using very sophisticated instruments to measure certain ballistic parameters and physical quantities and to observe specific, short duration events. Analog and digital electronics, flash X-ray, high-speed photography and microwaves are used extensively in automated and multi-purpose ballistic data handling systems. The facilities available for field trials, for example, enable scientists to visualize the separation of a warhead from its rocket motor, carry out studies on projectile fragmentation characterization, assess penetration properties of kinetic energy projectiles against concrete and steel targets and study projectile behavior in free flight.

Training Ammunition. A training projectile is being developed for use with aircraft firing 20-mm guns in the ground-attack role. The projectile is being made frangible so as to minimize any danger to the aircraft due to ricochet from the ground. This has involved considerable development work in material sciences (particularly power metallurgy) so that the mechanical properties of the projectile body may be tailored to give the desired combination of brittleness and strength.

The DREV Spinning Tubular Projectile (STUP) concept is now being exploited in the development of training/practice ammunition to simulate current finstabilized antitank projectiles. Special aerodynamic techniques, based on the "choking" phenomenon together with stability manipulation, are being utilized to tailor the drag of the projectile to give an acceptably short range so that the area required for training may be kept to a minimum.

Other development work is also going on, including a training projectile to simulate the M1 HE 105-mm artillery shell.

Armaments Field. Major achievements have been the CRV7 rocket system, an airborne tactical weapon, the spinning tubular projectile (STUP), a range limiting training round, and the General Vulnerability Assessment Programs (GVAM), a suite of computer programs for weapons systems performance modeling.

Electro-Optical Field. Past work on infrared sensors is being applied to passive surveillance equipment for the Canadian Forces. Since the technology breakthrough from DREV's invention of the CO_2 Transversely Excited Atmos-

pheric pressure (TEA) laser, laser work has been directed towards exploiting the use of both electrical and chemical laser concepts for active systems.

Advanced Data Processing Systems. ADP systems using digital computers and display systems, are being applied to tactical command and control concepts and various system studies.

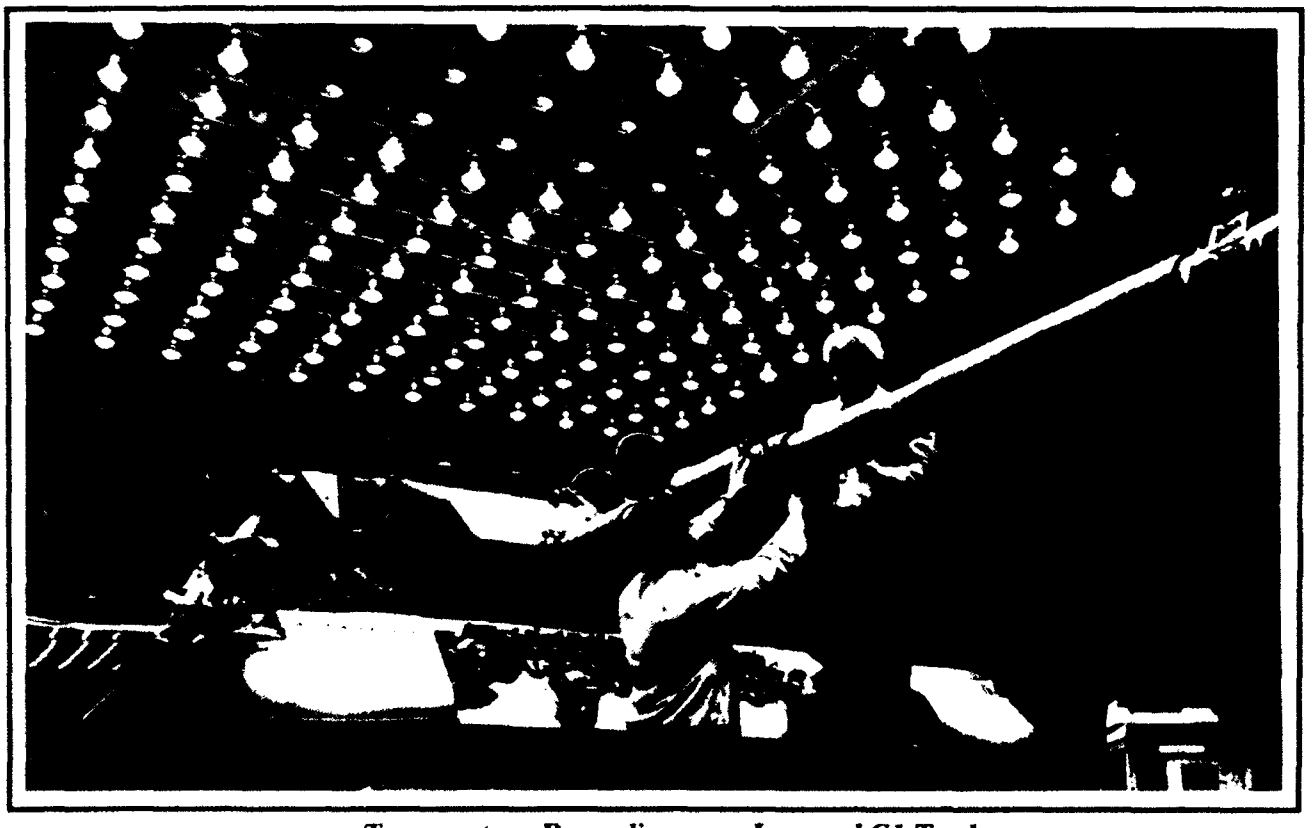
Within this context, DREV provides consultative support to the Canadian Forces in the acquisition of equipment and materiel, analyzes equipment failures or deficiencies and develops improvements, carries out feasibility studies, and develops and evaluates prototypes of new equipment. DREV also transfers technology to industry so that preproduction and production models can be manufactured, and provides expert support both before and after new equipment is put into service.

Technology Base. Basic technology applied research activities go on concurrently and are rounded out by extensive exchanges and cooperative activities with the NATO countries, Australia and New Zealand.

Research and Development. DREV's R&D work is carried out in four scientific divisions - Armaments, Command and Control, Electro-optics, and Energetic Materials - which are supported by the Administration and the Technical Services divisions and by the Civilian Personnel Office. The Plans and Programs Office provides program management support.

POINT OF CONTACT

Chief,
Defense Research Establishment
Valcartier, Quebec



Temperature Recording on a Leopard C1 Tank Under the Solar Heat Simulator

DEFENSE RESEARCH ESTABLISHMENT ATLANTIC (DREA)

MISSION

Provide scientific support to the Canadian Forces, particularly in underwater acoustics for submarine detection, hydrodynamics of ships and submarines and the material sciences of marine applications.

LOCATION

Dartmouth, Nova Scotia.

CAPABILITIES

Topography: A six - acre site with additional facilities including a lab in the Dockyard itself and outstations in the Dartmouth Dockyard Annex and on a barge moored in Bedford Basin. Excellent laboratory, computer and research ship facilities, together with programs at the forefront of science and technology, create a stimulating working environment for all DREA employees.

Functions:

Ocean Acoustics. Ocean experiments are used to study in detail the propagation of sound over a range of environmental conditions. The underwater sound measurement systems needed for these and other applications often make use of several hydrophones linked together in geometrical arrays. Advanced signal processing and computer techniques can then be developed to exploit small differences in the acoustic signals received by individual hydrophones, to provide bearing information and an improved signal-to-noise ratio. Sound propagation experiments and the exploratory development of new concepts require extensive sea trials and analysis. The acoustic research ship CFAV QUEST has been specially designed to provide the quiet platform needed for this task. The range of environmental conditions is wide, extending from the continental shelf, through the deep oceans to the Arctic. In the shallow waters of Canada's vast continental shelf, sound reflections from the bottom and subbottom layers, together with the effects of an abundant marine life, greatly complicate the sonar picture. Special techniques and research equipment are being developed to address these conditions. The shelf is of great civil as well as military importance. Consequently DREA coordinates its research in this area with other government agencies sharing a common interest in the seabed.

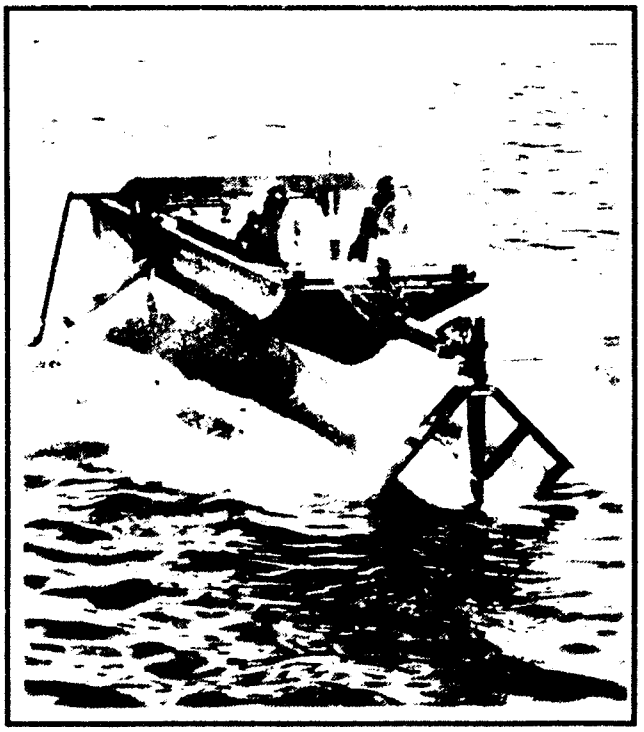
High Power Sound Projector Experiments

Hydronautics. There is a continuing need for effective but affordable warships tailored to the particular needs of Canadian maritime defence. DREA's hydronautics program is directed towards obtaining fundamental physical knowledge of the many factors influencing the performance of ships at sea, with the objective of developing improved methods for ship design and analysis. The program is concerned particularly with meeting the increasingly stringent requirements for seakeeping, propulsive efficiency, underwater noise and

structural behavior. Model tests and full-scale ship trials involve the combined skills of naval architects, engineers, physicists, mathematicians and technologists in providing data for validating fundamental theoretical studies.

Ship Dynamics. Naval ships must maintain fighting efficiency over a wide range of sea conditions, making good seakeeping vital. Recent years have seen marked progress at DREA in the development of analytical methods for the prediction of ship motions, bow slamming and deck wetness. Analytical techniques are being improved to determine in increasing detail the effect of hull lines and appendages on the ship motion characteristics and to predict the dynamic characteristics of towed sonar systems. The continued development of computer methods, supported by full scale and model seakeeping trials, will ensure that seakeeping can receive the major consideration it deserves in the overall assessment and comparison of new ship designs.

Assessment Studies. Assessment studies seek to determine how scientific and technological progress will influence future defence needs; and which of the many emerging systems and concepts hold most promise for Canadian maritime defence. These are comprehensive studies, involving experts from many branches of the military, defence science and engineering, sometimes from throughout the Western Alliance. They provide the broad perspective and good communications essential for long range planning, both for the Canadian Forces and for the DREA research program.



Model for Hydrofoil Development

Facilities:

Dockyard Laboratory. The Dockyard Laboratory, located in the CF Dockyard, Halifax, provides scientific consulting and troubleshooting services to the Canadian Forces - primarily the Maritime Command - on chemical, metallurgical and engineering problems which affect the operational capability of military vehicles and equipment.

Research Ship. DREA's research ship, the 2200 ton CFAV QUEST, was specially designed for open ocean acoustic research. Extreme measures were taken to reduce the transfer of sound from her machinery to the sea, preserving the low-noise environment essential for making sensitive acoustic measurements. QUEST is designed for operation in light ice conditions and has been used for experiments in arctic waters in the summer. Well set-up laboratories, excellent accommodations, good deck space, winches, cranes and other handling equipment combine to make her one of the more effective vessels for acoustic research in service today.

Typical Projects Supported:

Cathodic Protection. As a result of wartime research, the cathodic protection system was developed in the '50's to prevent underwater corrosion of ship hulls. A non-expendable anode was fitted to the ship hull and electrical power supplied to reverse the current normally caused by corrosion and, hence, to eliminate it. This system, which also required research to improve anti-fouling paints, has been adopted by most navies and shipping companies, with savings estimated in the millions of dollars.

Variable Depth Sonar. Wartime operations showed that submarines could not be detected by surface ship sonar when they ran beneath the warm surface layer that occurs in summer off the Canadian east coast. Early trials of a sonar lowered under the layer from a ship proved successful and verified the existence of a suspected sound channel, prompting the design of a towed Variable Depth Sonar (VDS) System. Since the '60's, such systems have become a major sonar equipment component in the destroyers of most navies.

Sonobuoy Development: Advances in conventional sonobuoys over the years have been more than offset by improvements in the performance and quietness of the submarine. The Vertical Line Array sonobuoy, pioneered by DREA in the '60's and developed by industry in the '70's, has now

been adopted by the Canadian Forces. This represents a new departure in sonobuoy design with a significantly improved performance.

Hydrofoil Ships. Research at DREA in the 1950's demonstrated that the seakeeping capability of the hydrofoil ship, both hullborne and foilborne, made it potentially the smallest surface vehicle capable of sustained anti-submarine operations in the open ocean. Consequently, the Canadian Forces embarked on an ambitious program in 1963 to design and construct the 200 ton HMCS BRAS D'OR, with De Havilland Aircraft of Canada Limited as the prime contractor.

Rough water trials validated the concept, showing the ship capable of maintaining high speed at least through sea state 5 and of having excellent seakeeping qualities when hull borne. Trials were discontinued when broad changes in defense policy ruled against so specialized an anti-submarine ship.

POINT OF CONTACT

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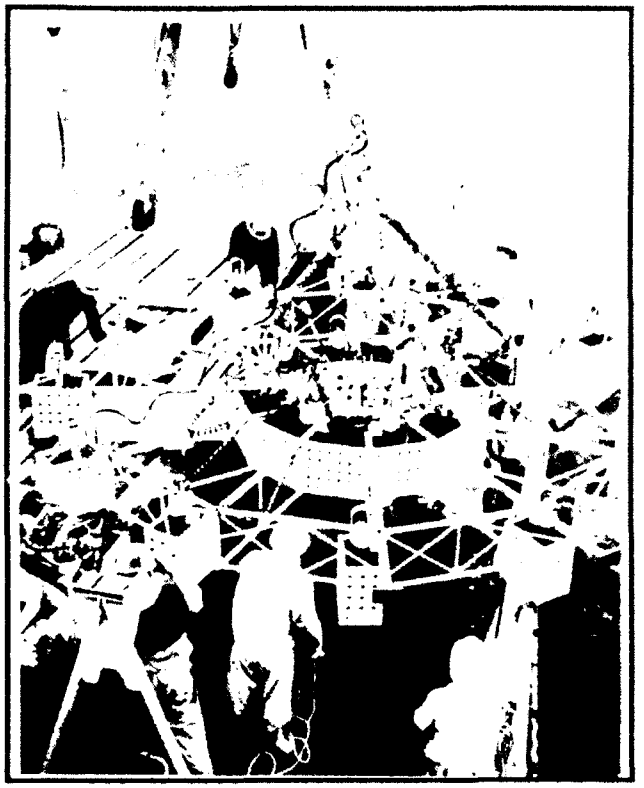
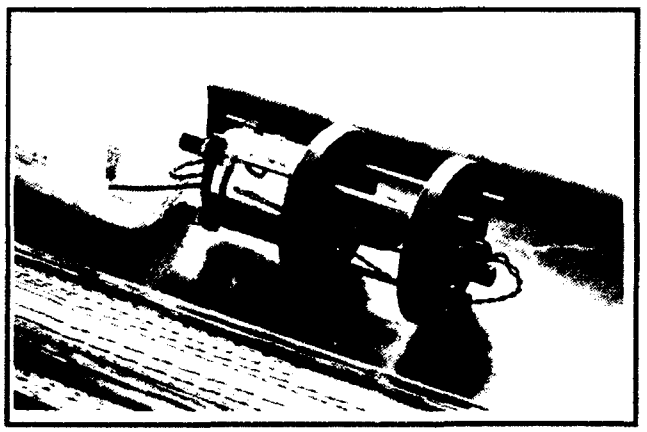


Hydrophones for Open Ocean Acoustic Research



Line Array Hydrophone

CANADA

DEFENSE RESEARCH ESTABLISHMENT OTTAWA (DREO)

MISSION

Conduct research on electronics, communications, radar, navigation and the protection of personnel and equipment.

LOCATION

Outskirts of Ottawa bordering south bank of the Ottawa River.

CAPABILITIES

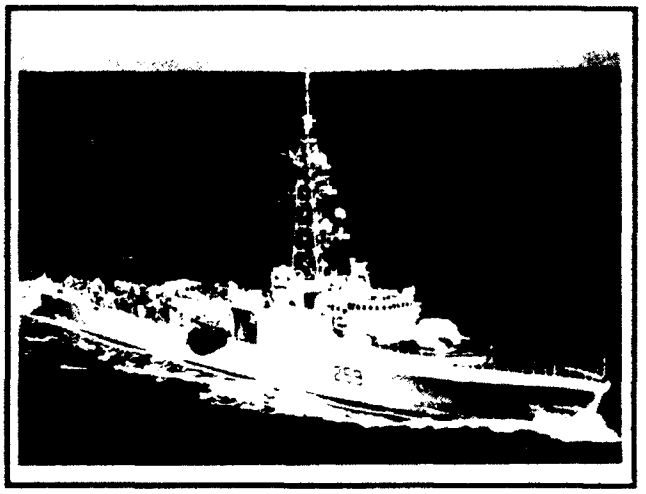
Functions: The Establishment maintains an ongoing association with many industries, universities and other government departments. Contracts for specific projects are awarded to universities and the private sector. Technologies developed are transferred to industry for the manufacture of a wide range of products.

International cooperation is another important aspect of Defense Research Establishment activity. Canadian Defense Scientists participate in a wide range of collaborative Defense research and Development with Canada's major allies, attend relevant conferences held around the world and participate in numerous multilateral international committees. Special ties link Canadian Defense Scientists with counterparts in Australia, New Zealand, the United Kingdom, the United States, and other NATO countries.

DREO obtains support services form DOC/CRC and from the Canadian Forces Base Ottawa. Defense Research and Development contracts to Canandian industries and universities account for the largest portion of the DREO annual budget.

DREO Research and Development activity encompasses six primary areas:

Space based systems research and development explores the use of space platforms to improve defensive capabilities and efficiency.



CANEWS Antenna Installation

Radar investigations examine techniques to provide more precise, rapid information about targets, particularly in the presence of terrain and weather "clutter."

Protective science programs focus on ways to protect the personnel, equipment, and machines of the Canadian Forces from the effects of nuclear radiation, chemical warfare agents, and adverse natural environments.

Navigation studies develop and miniaturize computer-integrated navigation systems for marine, helicopter and land vehicles.

Electronic warfare programs develop improved means of locating, identifying, intercepting, jamming and deceiving enemy radars. Technologies are also developed to locate, intercept and jam enemy radio communications.

Communications studies explore approaches to maintaining communication channels under adverse propagation and interference conditions, ranging from ionospheric refraction and reflection to the line-of-sight absorption experienced at Extremely High Frequencies or laser communications either direct or through satellite relay.

Advances in DREO Research and Development derive from the combined expertise of over a hundred Defense Scientists with bachelor, master and doctoral degrees, as well, as qualified technicians and various support services that include a library, shops, publication facilities and administrative management.

Typical Projects Supported:

Shipborne Low Angle Tracking. Tracking of sea skimming missiles and low-flying aircraft poses problems for shipborne microwave radar array antennas. A new signal processing approach devised by DREO involves detailed modeling of radar and propagation conditions. Theoretical and experimental studies have established the feasibility and superiority of the approach.

Radar Electronic Counter-Countermeasures (ECCM). Continuous efforts must be made to develop radar techniques that can overcome electronic countermeasures aimed at generating inaccurate or misleading radar information. DREO is investigating a number of approaches, including the adaptive nulling of antenna sidelobes, the use of frequency-agile and spread-spectrum signals, angle-agile beams, and electronic scanning. A phased-array radar using full electronic scanning and computer-controlled waveforms had been developed at DREO for experiments in support of this research.

Radar Electronic Countermeasures (ECM). Continuous enhancement of electronic countermeasures is necessary because of new radar types and fixes added to the existing systems of potential enemies. DREO develops effective countermeasures with its Engagement Simulator, a unique facility capable of both simulating a number of threat radar systems as well as measuring the effects of jamming signals generated by ECM equipment on victim radar systems. This facility assists research into novel ECM approaches and the development of programming techniques for the ECM systems of CF-18 aircraft and Navy frigates. Other projects include the development of expendable decoys for aircraft and ship protection against missile attack, new radio-frequency storage methods using high-speed digital techniques, and jamming concepts utilizing fundamental properties of the antenna of the victim radars. DREO has also developed expertise in the features that contribute to reflection of radar signals for aircraft and ships and in techniques for reducing these reflections.

Satellite Communication Ground Technical. Secure voice and data circuits are needed between remote sites and the Canadian Forces Base, Valcartier, Quebec. To produce the secure circuits DREO and CRC staff constructed a mobile terminal sized for Hercules aircraft transportation. The system uses Canadian domestic satellite capacity at Ku-band (14/12 GHz), and provides secure time-division-multiplexing of multiple voice and data signals. Both the necessary electronic equipment and and operator position were housed in a sheltered trailer. Articulated microwave guides were specially designed to feed the antenna. Heating and air conditioning permit operations in either the Arctic cold or the summer heat of southern Canada. Both the transportable and base terminals are under test by 711 Communications Squadron, Quebec.

Space Based Radar (SBR). Because SBR surveillance releases the radar system from many of the constraints of an earthbound or airborne system, DREO is exploring the application of SBR to the defense of North America against incursions by bombers or cruise missiles. Ambitious and technologically challenging, the DREO program in SBR shows potential for providing enhanced defense. The capabilities of present radar systems will be stretched to new horizons. Initial efforts are directed to the expansion of SBR technology within DND and Canadian industries, and to collaboration with he US Department of Defense.

Synthetic Aperture Radar High Resolution Images. Synthetic aperture radar systems can produce high resolution images through the application of digital processing techniques. DREO's success in this area has been directed to the problem of classifying ocean-going ships. Maritime patrol aircraft fitted with synthetic aperture radar will "spotlight" surface ships, providing classification at long range, during day or night, and in all weather. DREO is exploring other applications of synthetic aperture radar signal processing.

Canadian Electronic Warfare System (CANEWS). CANEWS detects the presence of radar systems in proximity to a ship, identifies the source, and makes detailed measurements of each radar pulse. Data from CANEWS provide a ship with the capability to cue defensive system (jammers, decoys) against attack by anti-ship missiles. Conceived and developed by DREO, CRC, and Canadian industry, the CANEWS radar-signal intercept system is in the process of being fitted to all Canadian warships.

Integrated Navigation Systems. To enhance the accuracy of navigation, modern computer techniques are used to integrate data form the NAVSTAR Global Positioning System, TRANSIT, Omega, Loran-C, Doppler and inertial systems. DREO's work on integrated navigation systems has resulted in the operational Marine Integration Navigation

System (MINS)), the developmental helicopter ((HINS)) and Arctic land vehicle (PLANS) prototypes.

The future of integrated navigation systems is bright in other fields. For example, such systems can enhance the quality of synthetic aperture radar imagery by compensating radar returns for antenna motion. DERO is exploring the application of fibre optics gyros, expert systems and new chip processors to compact, affordable systems and to Arctic submarine navigation.

Military Satellite Communications. A military satellite communications system must be secure against jamming, interception, or disruption of the signal propagation path. DREO, with assistance from CRC, develops the technologies and signal processing techniques necessary to maintain military satellite communications circuits for the Canadian Forces,including circuits useful in high Arctic regions.

Early experimental work demonstrated the feasibility of employing extremely high frequencies (20, 36, 38 and 44 GHz). Protection of individual communications circuits can be achieved through the use of extremely narrow beamwidth nulling antennas, spread spectrum modulation techniques, and the full processing of user signals on-board the satellite.

A 16 km Laser Test Range has also been established to explore the use of lasers for intersatellite data links as well as for covert, point-to-point, line-of-sight communications links, The range operates with a 10.6 millimeter CO2 laser capable of operation at data rates of up to 1 Mbit-per-sec.

Communication Electronic Warfare. Interception and location of enemy communications emitters is a vital part of battlefield electronic warfare, and also plays an important role in maritime operations. Frequency hopping radio, and other new radio types recently introduced into service by many countries, are difficult to detect by conversational receiver and direction-finding techniques. DREO has developed solutions to this problem, using new techniques such as microscan, digital filtering and demodulation, and acousto-optic receivers. One approach uses the time of arrival of a wave from an enemy transmitter at three spaced receiving stations. Attention has also been directed to the integration of all the information obtained from various electronic warfare systems.

Terrestrial Communications: Research and development in terrestrial radio communications provides the Canadian Forces with modern communications capabilities. The work, recognizing the unique characteristics of the various geographical areas of Canada, emphasizes the applications of powerful general purpose microprocessors and digital signal processing integrated circuits. Studies in various electronic counter-counter measures include sophisticated modulation methods that permit communications in the presence of interference, and self-adaption antenna arrays capable of pointing nulls in the direction of interfering transmitters.

Research in the networking of radio systems is directed toward improving both the speed and the reliability of high frequency communications. A packet-switched network system is expected to overcome problems caused by the ionosphere in the Canadian Arctic, as well as difficulties in Europe, where radio noise level is high because of intensive use of the spectrum. Techniques are also being developed to provide all Defence Research Establishments with easy and cost-effective access to ARPANET and other computer networks.

Extremely High Frequency (EHF) Satellite Communications. It is anticipated that at least a portion of any satellite communication system capability acquired by DND will be implemented in the EHF band, in order to exploit its potential for greatly enhanced circuit ruggedness. To prepare for Danaian or international EHF SATCOM procurements, DRE manages a major program within DNED and Canadian industry to develop a world-class level of expertise in this new area. The program focus is on the definition and construction of a functional model of an EHF system capable of demonstrating the advanced features available in modern military SATCOM systems.

Digital Voice Recording. A new technique for low-bit rate encoding of speech signals has been designed for DREO by CRC for secure field switchboard applications. Implemented on a single Texas Instruments TM320C25 chip, the device provides vastly improved voice quality and speaker recognition when compared with available technology. This achievement is the latest in a series of such projects licensed to Canadian industry for worldwide marketing .

Radar Electronics Support Measures (ESM). Intercepting, locating, and identifying radar emitters. Modern radars employ increasingly complex and exotic modulation techniques and extensions to the frequency band, demanding corresponding improvements in antennas, receivers, and processors. As the arrival rate of radar pulses can exceed a million pulses per second during engagements, performance of the receiver and processor is critical. Canadian ships now carry an ESM system designated and built in Canada. DREO is working on enhancements to this system and other ESM

requirements for aircraft and land systems. DSM work at DREO includes development of an integrated optics spectrum analyzer, processors using parallel microprocessors, custom VLSI preprocessors, expert systems software, and extensive hardware and software simulation capability.

NBC Mask. DREO has developed a new mask to protect the Canadian Forces from NBC (nuclear, biological or chemical) threats that may be encountered on the battlefield. The mask represents a significant advance in both design and polymer technology. Its features include outstanding increases in overall field of vision, speech intelligibility, a drinking system, easy reconfiguration to accommodate left or right handed personnel, and minimum 24 hours protection. The mask offers a number of major improvements in comfort, including availability in four sizes. Canadian Forces troop trials and extensive laboratory evaluations have been conducted to ensure full compatibility with all military equipment and protective clothing. DREO has worked closely with industry throughout the development program in order to transfer the technology for production of the mask.

Chemical Protection. DREO is developing equipment to protect the Canadian Forces against chemical and biological warfare agents as well as the effects of nuclear weapons, including radioactive fallout. Protective clothing, gloves and boots must protect the body from percutaneously acting agents, while masks and canisters must protect the eyes and respiratory tract from toxic vapours and aerosols. Activities that range from research on new materials to the design, development and evaluation of equipment using these materials involve a wide variety of disciplines--chemistry, chemical engineering, physics, mechanical engineering, clothing, and textile science, physiology,and human performance.

DREO has completed a major project to develop a new protective mask to meet the needs of the Canadian Forces in the 1990 to 2000 timeframe and is now concentrating on the development of the next generation of protective clothing. The new clothing program will look at ways to integrate NBC protection into combat clothing, study methods of reducing the physiological penalty and performance degradation imposed by this type of clothing, and ensure that protection is provided against chemical and biological agents that could be encountered on the battlefield at the turn of the century.

Mobile Nuclear Spectrometer . A mobile fast-neutron and gamma-ray spectrometer to measure long-range airtransported radiation and the related protection afforded by armoured vehicles. Data from the Mobile Nuclear Spectrometer have contributed to a better understanding of the toxicity of radiation to man.

POINT OF CONTACT

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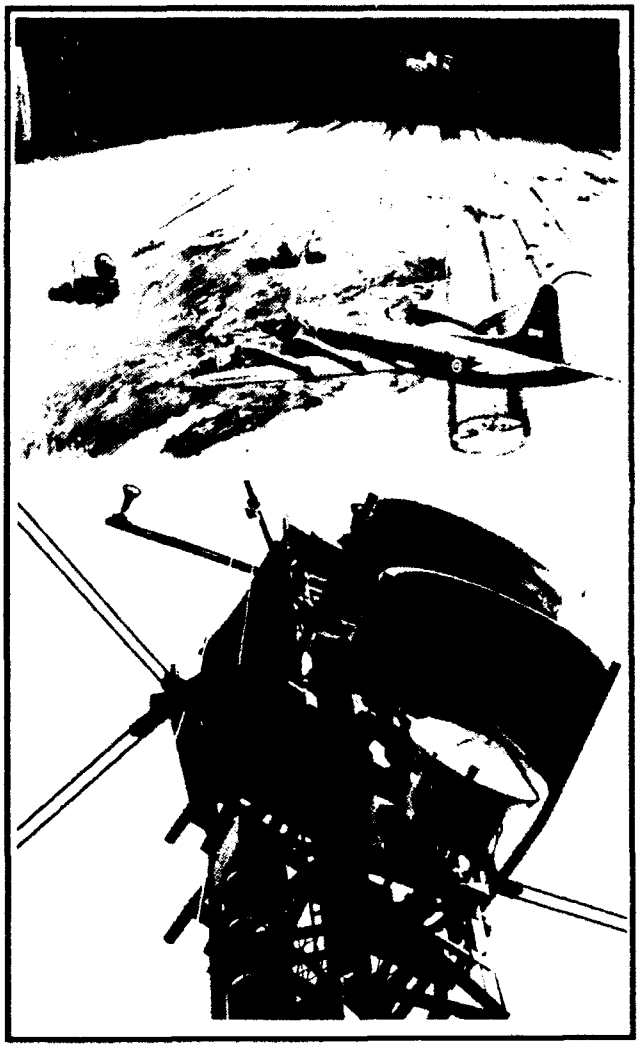


Satellite Communications Systems

CANADA

DEFENSE RESEARCH ESTABLISHMENT PACIFIC (DREP)

MISSION

Conduct research and analysis of the impact of the environment of the North Pacific and Arctic Oceans on military systems performance. Carry out scientific programs in acoustics, electromagnetics, fluid dynamics and materials engineering.

LOCATION

Esquimalt, Vancouver Island, British Columbia

CAPABILITIES

Topography: North Pacific and Arctic operating areas.

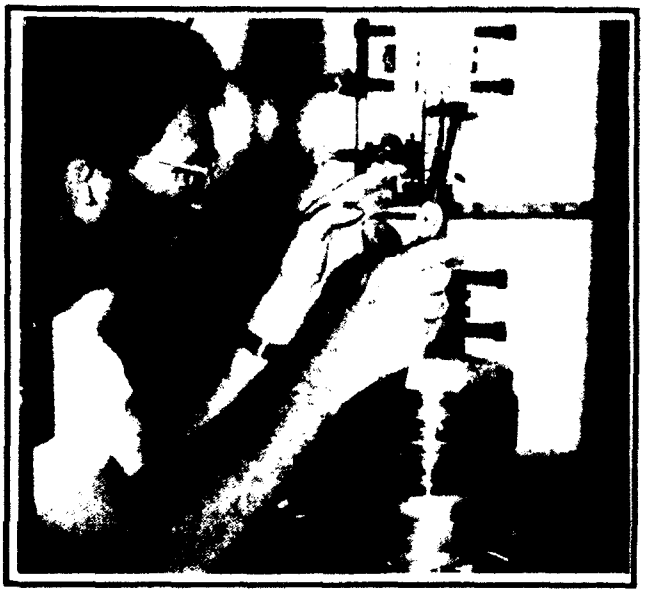
Functions: The Defense Research Establishment Pacific (DREP) is located at Esquimalt, British Columbia. Its personnel have developed extensive scientific expertise concerning the north Pacific Ocean and the severe environment of the Arctic, especially in the acoustics, electromagnetics and materials engineering fields.

The underwater acoustics research program addresses sound propagation, background noise and other characteristics of the Northeast Pacific and Arctic Oceans which affect submarine detection and tracking.

In arctic waters, studies are aimed at environmental acoustics and the problems associated with installation of equipment in harsh arctic conditions. Field trials are normally held during expeditions involving temporary or semi-permanent camps on sea ice.

Research in electromagnetics looks at methods for detecting submarines as well as mine countermeasures.

The recently initiated mine countermeasures program is studying means of suppressing sources of electric and magnetic ship-generated signals which could trigger mines. It is also developing technology to locate and identify mines deployed in waters of Canadian interest.



Fatigue Testing of Composite Component

These areas of physical research are supported by studies inside and outside DREP concerning sophisticated signal processing, information theory, and numerical analysis aimed at the application of automated data-processing to advanced detection systems.

Materials engineering research has concentrated on the stringent requirements for military equipment which must operate in adverse environments.

Work on composite materials and on nondestructive evaluation of composite materials has increased markedly over the last ten years, in support of new equipment such as Canada's new high-performance jet fighters.

Work on machinery health monitoring has resulted in the development of on-line monitors for use in fixed- and rotary-wing aircraft to detect wear problems which might lead to

engine failures.

Direct engineering consultative support is also provided to the Canadian Forces, and was instrumental in resolving a potentially serious cracking problem in boilers on DDE class ships.

Facilities: For Northeast Pacific studies, the research ship CFAV ENDEAVOUR is fitted with a towed acoustic array and a computer-based data acquisition and display system. This system provides real-time output for studies of system performance. Support investigations include an extensive study of passive ranging techniques for towed arrays, experimental studies of the ocean acoustic environment and the development of reliable propagation modelling.

Research to exploit magnetic anomalies induced by submarines has resulted in the selection of improved test areas for long-range patrol aircraft, a magnetic anomaly detection (MAD) simulator for aircrew training and an automated magnetic anomaly detector suitable for operation in both fixed- and rotary-wing aircraft. In addition, a long-term project is investigating gradiometers, which are expected to become the next generation of magnetic anomaly detecting devices.

Typical Projects Supported:

Shipboard Sonar Performance Prediction and Display Systems. Ongoing research at DREP has produced an improved version of the parabolic equation (PE) model for making predictions of coherent sound propagation loss in the ocean. This information is useful in estimating the performance of low-frequency passive sonars such as CANTASS.

The widespread use of the PE method for predicting underwater sound propagation arises from the fact that it provides full-wave acoustic predictions in range-varying environments in a relatively short time. With this model, sound propagation loss may be quickly and accurately computed at all depths in the water column out to an arbitrary maximum range.

Research in Support of the New High-Performance Fighter Aircraft. In the early 1980s the Canadian Forces acquired a new fleet of high-performance jet fighters, the CF- 18. Their anticipated arrival sparked many CRAD research and development projects, including two major programs undertaken by DREP in 1978.

The first, research into advanced composites, derives from the fact that up to 40 per cent of the CF-18 skin is made from a graphite fibre/epoxy composite material. The second, a program of nondestructive evaluation, is aimed at the identification of flaws and improvement of flaw detection and measurement techniques in the composite materials and their joints. This program is also being applied to metallic structures in aircraft.

Phase Insensitive Transducer Development. DREP recognized that inspections performed using conventional piezoelectric ultrasonic transducers could not provide accurate flaw size data due to phase cancellation effects that occur at the face of the transducers. Research and simulation by DREP demonstrated the benefits of phase insensitive reception for quantitative flaw measurements.

POINT OF CONTACT

Chief Defense Research
Establishment Pacific (DREP)
HMO Dockyard/FMO Victoria
Canada VOS/BO

Telephone: (604) 380-2868

Scientists Onboard ARGUS Aircraft

CANADA

DEFENSE RESEARCH ESTABLISHMENT SUFFIELD (DRES)

MISSION

To support the Canadian Forces by conducting both laboratory scale research and related large scale field trials, involving twenty scientific/engineering disciplines.

LOCATION

Ralston, Alberta, near Medicine Hat

CAPABILITIES

Topography: Flat, high, plains, dry grassland.

Functions: DRES is one of six R&D Establishments across Canada which operate under the civilian Chief of Research and Development (CRAD) of the Department of National Defense. Each specializes in different fields of defense research. Their objective is to bring to the Canadian Forces the best and latest in scientific knowledge and accomplishment related to defense. DRES has been pursuing this objective for over forty years. Functional objectives include:

Defenses for Canadian Military personnel should they ever be attacked by chemical weapons. (Canada has no offensive chemical capacity.)

Methods of detecting invisible nerve gases which can kill in minutes.

Clothing which can protect and ways of decontaminating persons and equipment which are contaminated.

Research to find ways of making personnel immune to the effects of chemical agents, and also to find ways to treat cases of gas poisoning.

Methods that the Canadian Forces can use in training to defend themselves and to continue operating should they be attacked with chemicals.

The ROBOT-X with Five CRV-7 Rocket Motors Used for Launch Boost

Undertaking similar types of research with respect to defense against biological warfare agents - to detect and to identify dangerous bacteria and viruses, to devise protective clothing, to devise methods for decontaminating equipment, clothing and terrain contaminated with bacteria or viruses, to determine the characteristics of the spread of biological agents.

A highly active program studying the active transmission of naturally-occurring respiratory diseases (flu, common cold, pneumonia and meningitis) and aimed at controlling these diseases in Canadian military populations.

Research aimed at a better understanding of respiratory diseases and of meningitis.

Sophisticated methods of monitoring the state of health of personnel manning weapons and sensors (e.g., radar).

Developing airborne target systems that can be used for training operators of guns or missiles. These experimental targets take the form of small aircraft (remotely controlled), rockets and dirigibles. All involve instrumentation which tell the operator how well he's doing.

A vested interest in learning about the many problems of operating military vehicles off the road in the Canadian and Norwegian Arctic.

Ways to program computers so that they will tell us whether or not we can drive from A to B, and if not, from where to B.

Developing highly sensitive devices for detecting metallic objects underground, devices which will tell us how deep an object is, how large it is and possibly what it is.

It takes a lot of skilled people to have a significant impact upon the problem areas outlined above and DRES has just 200 people. So a lot of research (and development) is done by others. Contracts exists with Canadian universities from coast to coast, from the University of Victoria to Dalhousie University plus contracts with Canadian industry at many centers in Canada and also with Canadian hospitals where research is done.

Another way to get information is by trading. Formal agreements exist to exchange information with defence scientific organizations in several other countries, close work is done with counterparts in the NATO countries, as well as with those in Australia and New Zealand. Routine laboratory visits are conducted in Canada and in other countries, including Australia and New Zealand. As a member of the CRAD organization, the services of the Canadian defense research liaison staffs in Washington, London, Paris and Bonn are routinely employed.

Facilities: The following is a brief summary describing the work of the sections within DRES.

Chemistry Section:
- protection and training against chemical attack,
- develop training simulations and associated hardware, and
- investigate effectiveness of protective equipment and procedures.

Preventive Medicine Section:
- protection and training against biological attack including clothing, procedures and methodology, and
- microbiological aspects of military preventive medicine including the study of respiratory disease (viral and bacterial), meningitis and the disease resistance process in humans.

Biomedical Section:
- treatment of casualties of chemical warfare agents by self administration or medical corps personnel, and
- medical assessment of vital signs (heart rate, blood pressure, etc.) without breaking the seal of protective clothing.

Military Engineering Section:
- explosive physics/detonation phenomena,
- structural response to shock and blast,
- military demolitions and cratering, and
- computer services to DRES.

Systems Section:
- aerial targets technology; Remotely Piloted Vehicle (RPV) systems,
- range clearance technologies; mine/countermine warfare techniques and training,
- naval combat systems performance monitoring, and
- electronic design, radio net, instrumentation for DRES.

Vehicle Mobility Section:
- terrain analysis and computer modeling of vehicle mobility,
- technology improvement for off-road vehicles,
- cold weather operational problems, and
- experimental model (machine) shop services.

Field Operations Section:
- preparation of equipment and support for field trials,
- maintenance of laboratory and field research facilities and equipment,
- casting and handling of explosives, and
- coordination of outside agencies who use range area/facilities.

Program Support Office Services:
- Photography--
  + specialists in technical photography,
  + video cameras and displays, and
  + art work and design.
- Meteorology--
  + weather forecasts - instantaneous weather anywhere in Western Canada and U.S.A.
  + seismic vault - earthquakes recorded.
- Canadian Forces Liaison Office--
  + the link between DRES and the Canadian Forces,and

+ Military Advisor to the Chief.

- Information Services--
  + scientific journals and defense reports,
  + searches of the literature by computer, and
  + printing and publishing facilities.

Administrative Division

- control of DRES resources,
- financial administration for travel, services, supplies, equipment,
- purchase and distribution of equipment and supplies,
- central registry, security and safety,
- coordination of support services, and
- Medical Advisor to the Chief.

POINT OF CONTACT

Chief,
Defence Research Establishment Suffield,
Ralston, Alberta
TOJ 2NO

Telephone: (403) 544-3701 (Ext. 202)

DEFENSE AND CIVIL INSTITUTE OF ENVIRONMENTAL MEDICINE (DCIEM)

MISSION

Provide research and development required to support the broad operational commitments of the Canadian Forces.

LOCATION

Downsview (Ontario) Canada.

CAPABILITIES

The following indicate the scope and characteristics of the programs carried out at the Institute.

Applied Psychology:

Command and Control: Emphasis is on information requirements, specification and presentation data entry techniques, and facility design and layout.

Information Presentation. Research is concerned with the perceptual and cognitive capabilities of man related to the auditory and visual presentation of information from passive sonar and sonar arrays.

Performance Under Stress. Psychophysiological measures determine work-rest schedules appropriate for sustained military operations and for command and control personnel when sleep deprived. In addition, cognitive and vigilance performance is assessed under varying degrees of ship motion.

Training and Simulation Technology. Valid performance measurements must be established to measure the effectiveness of various devices in order that cost-effectiveness can be estimated. Because of the high costs associated with simulation, the degree of visual fidelity to produce efficient training is also under study. Also, research into "human" computer languages and interfaces is under way to provide computer-based teaching systems.

Evaluating a Tactical Life Support System

Noise, Vibration and Vision. The noise program entails the measurement of noise sources, the evaluation of various protective devices, and the recommendation of exposure limits, with the long-range goal of reducing the risk of noise-induced hearing loss in military personnel. Research on vibration is oriented towards ensuring adequate crew comfort and working efficiency in the many types of vehicles used by Canadian Forces. Visual problems include detection probabilities in visual search for downed aircraft, night vision units, weapon sights, and the protection and comfort afforded by sunglasses.

Human Engineering:

Man/Machine Systems Evaluation. Evaluations performed to identify design deficiencies and potential hazards in order to recommend methods for alleviating man/machine interface design problems.

CANADA

Man/Computer Interface Design and Evaluation. To ensure that electronic display devices, data entry and control devices, and especially, display system software are designed to facilitate task performance.

Anthropometry and Biomechanics. Projects aimed at obtaining data on the anthropometric characteristics of various military groups for application to man/machine-interface design specifications. Work also involves the development of selection standards.

Workplace Design. Work ranges from the human engineering design of a one-operator console to the layout and crew-station design of multi-operator compartments.

Aerospace Life Services:

Aerospace Physiology. Efforts in understanding and overcoming the problems of disorientation and motion sickness, as well as the prevention of acute hypoxia at altitudes greater than 15,000 meters.

Aerospace Life Support Systems. Developments of new, more sophisticated life support equipment to protect aircrews in normal operations and emergencies.

Accident Research. Identify and assess the stress-related human factors in Canadian Forces aircraft accidents and develop an accident analysis and data processing system.

Biodynamics. Concerned with the effect on humans and equipment of the mechanical forces which are experienced on impact or during rapid acceleration/deceleration.

Diving. Within its diving program DCIEM conducts research on diving medical problems, develops, tests and evaluates diver life-support equipment, provides the facilities and expertise for diving medical training, and investigates diving accidents.

Environmental Stress:

Physical Fitness and Work Physiology. Research is performed on methods of developing physical fitness and on tests for measuring the fitness level achieved, and on the relationship between the individual's life style and his physical condition.

• Climatic Physiology Physiological responses and adaptation to heat and cold are studied with the aim of developing, on the one hand, equipment for protecting the individual against climatic extremes and, on the other, operational procedures for minimizing the effects of the sudden changes in climate involved in rapid transportation from one part of the world to another.

Stress Biology. Studies concerned with evaluation of altered immune functions under stressful environmental conditions, including physical fatigue, sleep deprivation and sustained operations. The role of nutrition and physical activity on the immune system is of interest as well.

Occupational Health. This research addresses the biomedical and performance aspects of occupational safety and health and the control of hazardous materials in the context of both military operations and environmental quality.

Medical Assessment and Training:

Central Medical Board. The broad has a three-fold responsibility in support of Canadian Forces activities. The medical status of all aircraft applicants is assessed and in some cases additional examinations are performed before a decision is reached on the candidates' suitability. The board acts in a reviewing role to determine if operational aircrew medical problems may compromise performance duties. As a central body it ensures standardization of assessment and consistent interpretation of physical parameters for aircrew personnel.

School of Operational and Aerospace Medicine. The School is a source of specialist training within the Canadian Forces, supplying courses in, for example, aerospace medicine, diving medicine and aeromedical technology. In performing its teaching role it must ensure that it maintains a knowledge of the current state-of-the-art in these subjects. The close interaction which exists between the school and the Institute's research and development divisions is of great assistance in achieving this aim. The school facilities which include low pressure chambers, a human centrifuge, and orientation and procedure trainers are used for both teaching and research.

POINT OF CONTACT

Chief
Defense and Civil Institute of Environmental Medicine
1133 Sheppard Avenue West
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Downsview, Ontario
M3M3B9

Telephone: (416) 633-4240

DAVID FLORIDA LABORATORY (DFL)

MISSION

Provide Canadian national facility for spacecraft assembly, integration and test.

LOCATION

Owned and operated by the Canadian government, the DFL is located within the Communications Research Center (CRC) complex of Communications Canada. Its facilities are available on a cost recovery basis to the Canadian and foreign aerospace and communications communities for use on domestic and export projects.

CAPABILITIES

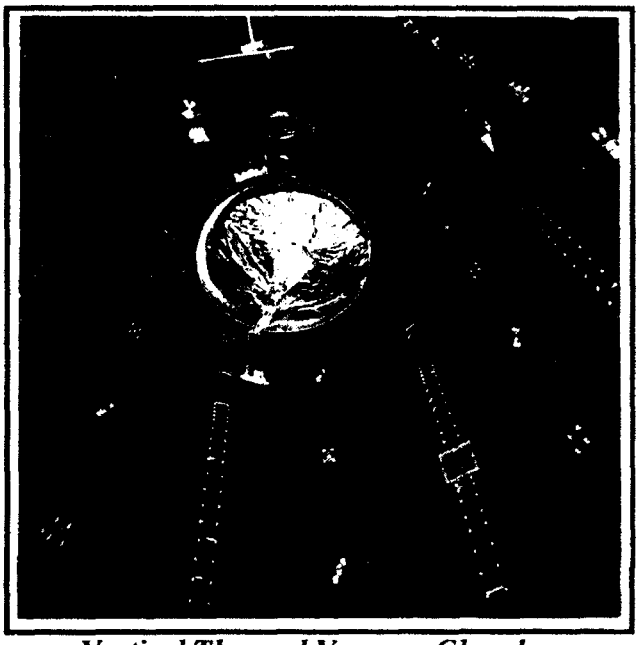
Facilities: The integration and assembly areas of the DFL comprise three large, temperature (22°C ± 3°C) and humidity (45% ± 5%) controlled clean rooms with a total area of approximately 2100 sq.m. All high bays have a class 100,000 clean room rating and when required class 10,000 can readily be made available. The three high bay areas are separately traversed by traveling bridge cranes with hook heights of 9m, 11m and 16m respectively.

An important component of DFL's operation is its commitment to the development of new test technologies to permit the qualification of space hardware which defies testing by usual techniques due either to size, complexity or other limitations. New thermal, structural and RF payload verification techniques will be required by future projects such as Radarsat, MSAT and the Space Station.

The RF Test Facility consists of two anechoic chambers, a roof-top range, an EMC Facility and a PIM Facility.

The anechoic chambers and roof-top turntable provide outdoor ranges for antenna measurements. The 3-axis positioners and sources are controlled via a fibre-optic link between the 62m tower and control room. Data acquisition is controlled by the S/A 2020 Antenna Analyzer, HP8510A Network Analyzer, or S/A 1750 Receiver/Recorder.

The EMC (electromagnetic compatibility) Facility provides capabilities for radiated and conducted emission (RE and CE) and susceptibility (RS and CS) tests. The shielded room houses the unit-under-test (UUT); the shielded anteroom houses the customer's test equipment that operates and monitors the UUT; and the Faraday Cage contains DFL's test equipment.



Vertical Thermal Vacuum Chamber

The PIM (passive intermodulation measurement) Facility provides a means of evaluaing the magnitude and characteristics of PIM products generated within typical spacecraft components and subsystems. The test sets can also be used to detect multipaction breakdown which causes loss of radiated power, increases degradation of conductor elements and produces PIM.

Associated Customer Support Facilities:

Customer support facilities include 606 sq.m of office space along with three suitably equipped meeting/conference rooms, the largest of which can accommodate up to fifteen people. Larger meeting areas are also available through CRC.

CANADA

POINT OF CONTACT

David Florida Laboratory
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Ottawa, Ontario
Canada
K2H 8S2

Telephone: (613) 998 2383
(613) 998-2433 (FAX)
(613) 053-4143 (Telex)
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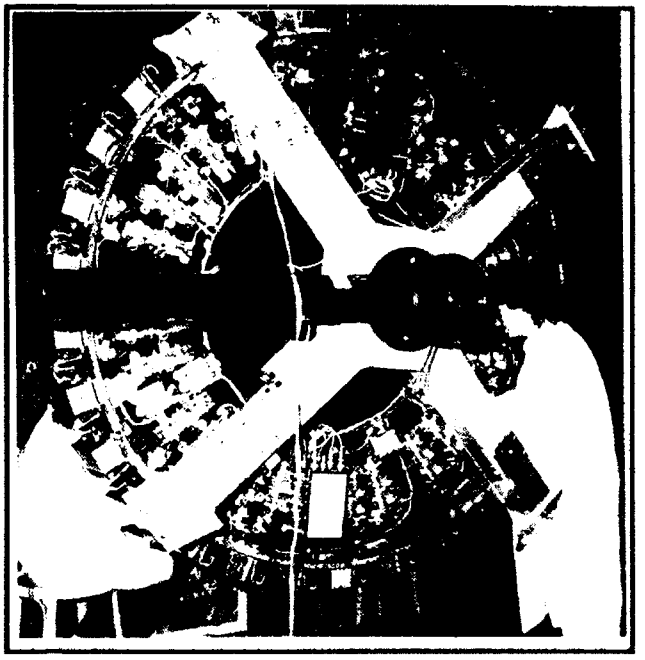
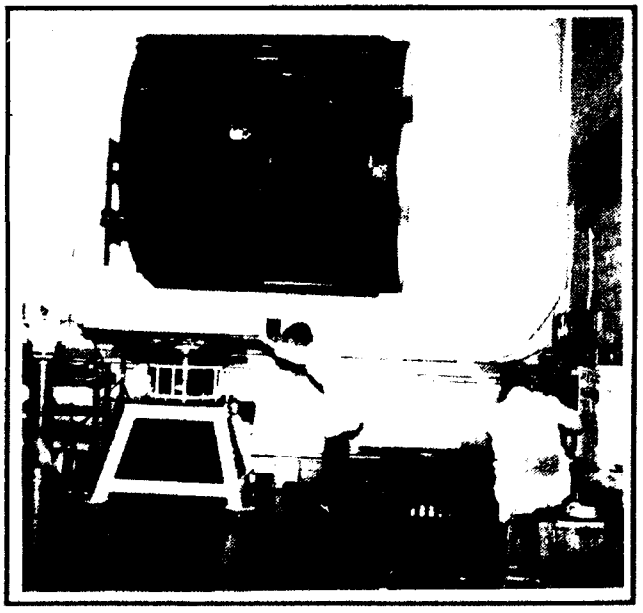


ANIK-D Satellite Undergoing Mass Properties Measurements



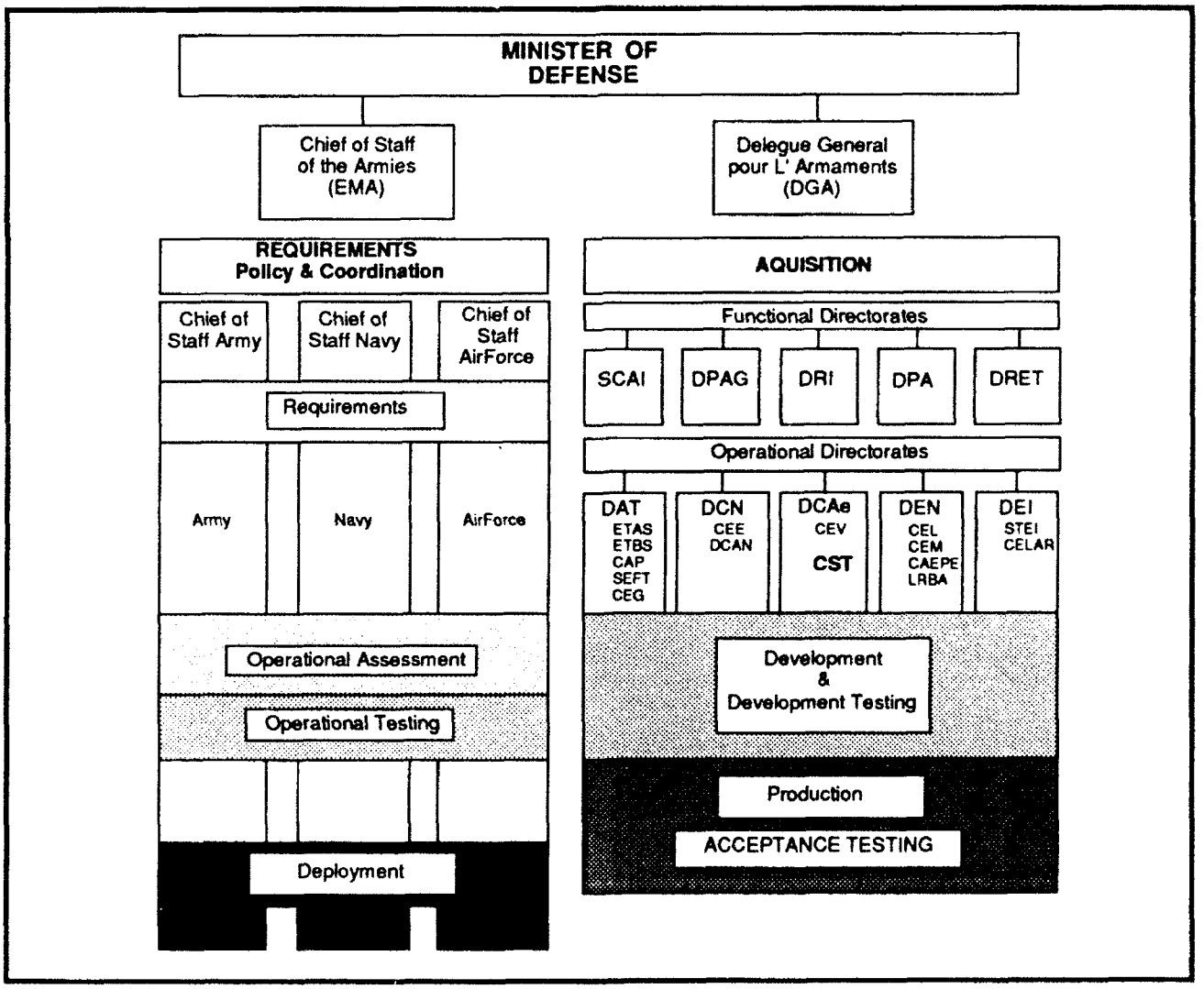
Brazilsat Satellite (SBTS)

FRANCE

FRANCE

The Chief of Staff of the Armies (EMA) is responsible for development of policy and coordination of long term plans and weapon system requirements identified by the Military Services.

The Delegue General pour L'Armaments (DGA) is responsible for the acquisition of military systems and equipment for the Minister of Defense to meet approved requirements. In close collaboration with the Chiefs of Staff, he prepares armament research, design and manufacturing programs, submitting them to the Minister of Defense for approval. The figure below illustrates the organization of Defense Management Directorates in relation to the acquisition process. The organization of the DGA includes five functional directorates and five operational directorates.



Defense Management Directorates

France

FUNCTIONAL DIRECTORATES

Central Service for Armament and Industrial Affairs (SCAI). Instigates, via the Service de la Surveillance Industrielle de l'Armament (SIAR), action of the DGA to ensure quality control of armament production.

Personnel and General Affairs Directorate (DPAG). General administration for DGA and staff training.

International Relations Directorate (DRI). DGA interface for international trading.

Delegation for Armaments Programs (DPA). Programmatic work on behalf of the DGA.

Research, Studies and Techniques Directorate (DRET). Manages all aspects of research upstream of development.

OPERATIONAL DIRECTORATES

Direction des Armaments Terrestres (DAT). Development and production of land warfare systems.

Direction des Constructions Navales (DCN). Development and production of ships and ship systems.

Direction des Construction Aeronautiques (DCAe). Development and production of aircraft and helicopters systems.

Direction des Engins (DEN). Development and production of missile systems.

Direction de L'Telectronic et de L'Informatique (DEI). Studies and programs on C^2 systems. Coordination of industrial policy for electronics and microprocessors.

T&E FACILITIES

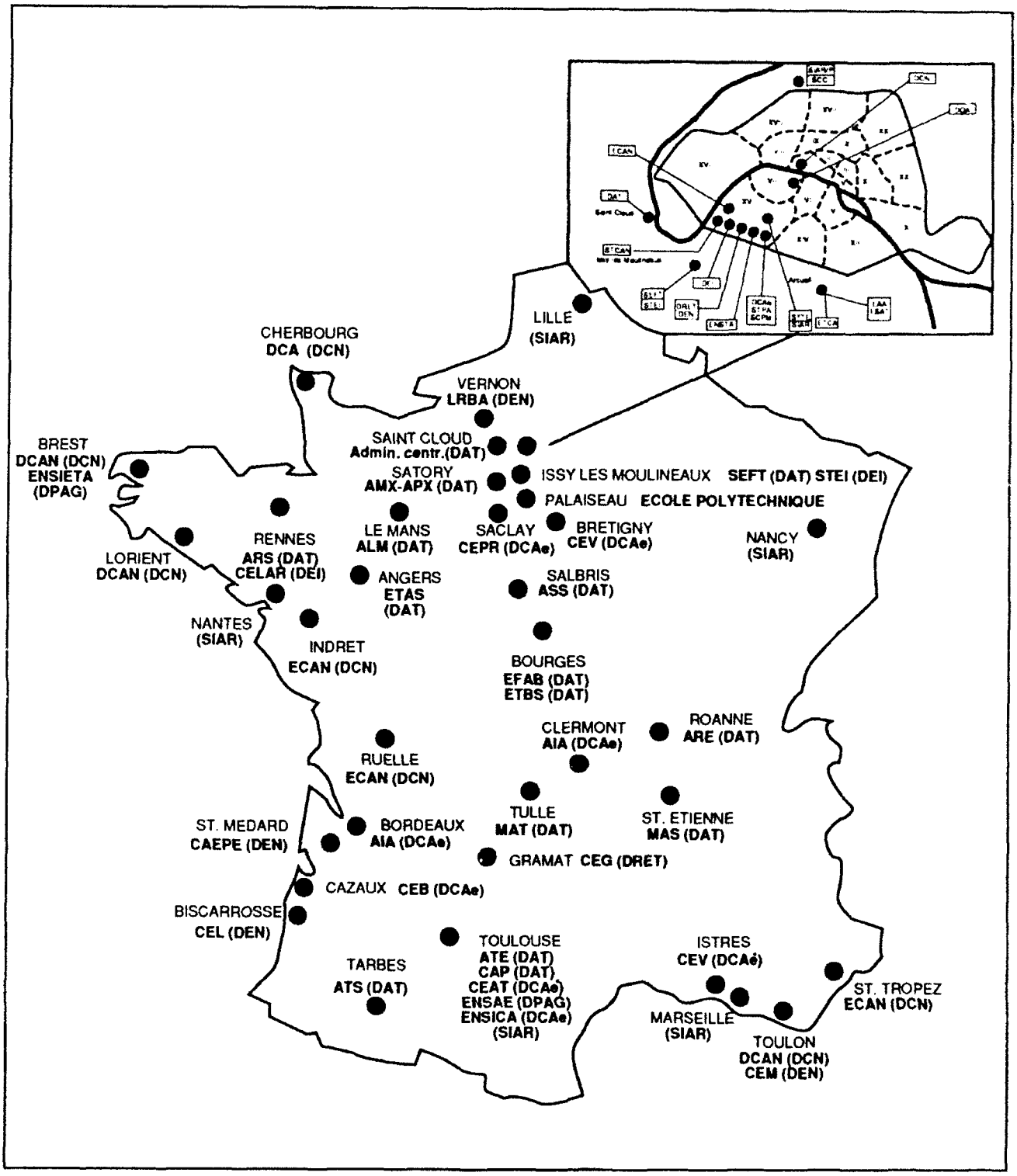
In general the T&E facilities are acquired or developed and managed by the operational directorates. T&E facilities are located throughout France, and in the Azores. The Services are involved throughout the acquisition process as evaluators and advisors.

Developmental Testing. Conducted by or under supervision of the operational directorates. The Services assess the technologies and development for responsiveness to the operational requirements.

Operational and Environmental Testing is conducted by the Military Services with operational personnel. Results are provided to DGA and the Industrial Armament Surveillance Service (SIAR). The Service does not have to accept complete responsibility for equipment until the means to perform the maintenance function is fully defined and in place (trained personnel, tools, spares, test sets, special equipment, documentation and guaranteed by the manufacturer or the DGA that spares will be available for a period of 17 years at reasonable cost).

The DGA finalizes the acceptance conditions of the equipment. Production commences after subject equipment is officially adapted.

Acceptance Testing. Performed by the SIAR.


LILLE
(SIAR)
CHERBOURG
DCA (DCN)
VERNON
LRBA (DEN)
BREST
DCAN (DCN)
ENSIETA
(DPAG)
SAINT CLOUD
Admin. centr.(DAT)
SATORY
AMX-APX (DAT)
ISSY LES MOULINEAUX
SEFT (DAT) STEI (DEI)
PALAISEAU
ECOLE POLYTECHNIQUE
LE MANS
ALM (DAT)
SACLAY
CEPR (DCAe)
BRETIGNY
CEV (DCAe)
NANCY
(SIAR)
RENNES
ARS (DAT)
CELAR (DEI)
LORIENT
DCAN (DCN)
ANGERS
ETAS
(DAT)
SALBRIS
ASS (DAT)
NANTES
(SIAR)
INDRET
ECAN (DCN)
BOURGES
EFAB (DAT)
ETBS (DAT)
CLERMONT
AIA (DCAe)
ROANNE
ARE (DAT)
RUELLE
ECAN (DCN)
TULLE
MAT (DAT)
ST. ETIENNE
MAS (DAT)
ST. MEDARD
CAEPE (DEN)
BORDEAUX
AIA (DCAe)
GRAMAT CEG (DRET)
CAZAUX CEB (DCAe)
BISCARROSSE
CEL (DEN)
TOULOUSE
ATE (DAT)
CAP (DAT)
CEAT (DCAe)
ENSAE (DPAG)
ENSICA (DCAe)
(SIAR)
TARBES
ATS (DAT)
ISTRES
CEV (DCAé)
ST. TROPEZ
ECAN (DCN)
MARSEILLE
(SIAR)
TOULON
DCAN (DCN)
CEM (DEN)

DGA Sites

France

SERVICE CENTRAL DES AFFAIRES INDUSTRIELLS (SCAI)

MISSION

Carry out DGA's duties related to industrial affairs concerning all armament industries in the public, semi-public or private sectors.

FUNCTIONS

To meet the need for knowledge of (1)the material, human and financial potentials of the armament and aerospace industries, (2)of their expected activities and of their structures, as well as (3)of the international environment, the SCAI prepares the Delegue General's and Ministerial decisions on industrial policy, particularly in the following domains:

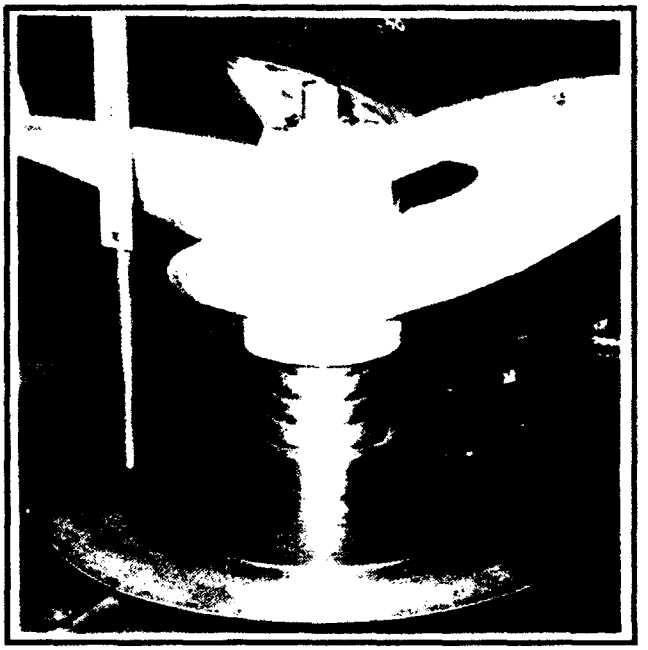
- improvement of competitiveness and profitability,
- forward planning (investment programs, evolution of structures),
- guidelines of State establishment activities,
- guidelines for Defence contracts,
- independance of the armament activity, and the
- contribution of the armament sector to the main national economic goals.

The SCAI also instigates, via the Service de la Surveillance Industrielle de l'Armement (SIAR), the action of the DGA with regard to the quality control of armament production.

The objective of the SCAI is to place all firms involved in the production of armament equipment in the best possible conditions of competence and competitiviness, in order to meet the needs of the nation and of friendly countries.

RAQ

SIAR must ensure that companies' quality control systems meet the criteria specified in the "Reglement d'Assurance de la Qualite" (RAQ). The French quality assurance system is fully compatible with the "Allied Quality Assurance Publications" (AQAP).



Propeller Test

These regulations establish three ranges of criteria of varying degrees of detail, dealing with appropriate organization and methods, to suit the type of product of service.

SIAR inspects premises to evaluate compliance with these Regulations and successful plants are issued with a certificate stating they satisfactorily meet RAQ requirements (RAQ-class certification).

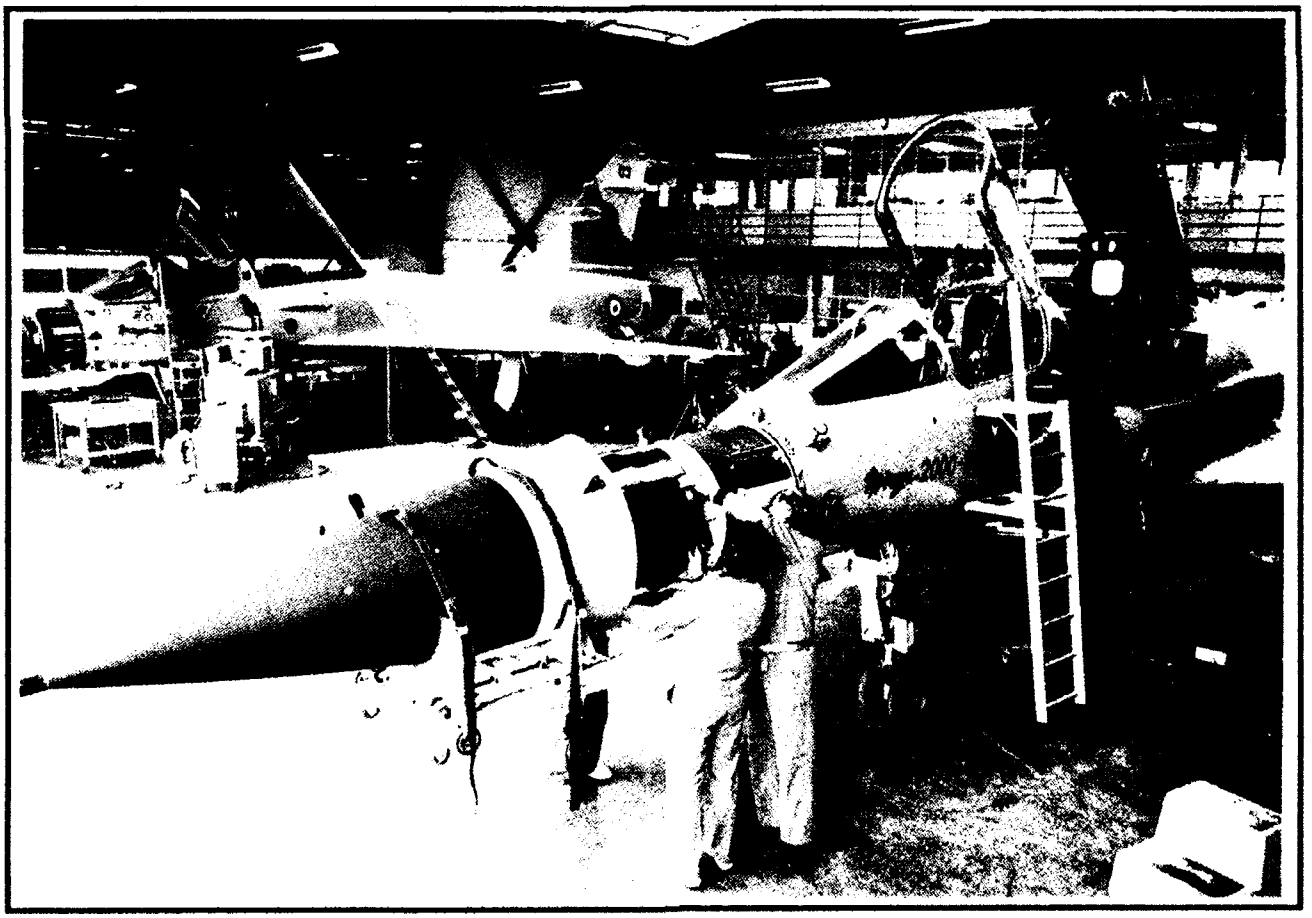
French industry exports materiel to many countries and SIAR can act as the official certifying body for customer requirements, just as it does for the French Forces.

Where bi- and multilateral programs are involved, SIAR consults with its counterpart organizations in the partner countries to draft an agreement whereby each partner will supervise the goods manufactured in its own country on behalf of the other countries. These agreements stipulate how the organizations liaise.

SIAR can assist foreign governments in designing and setting up quality control authorities and in training specialists in quality control methods.

The high reputation of French military equipment resides first and foremost on its high standards. Product quality is the province of the manufacturer and quality control systems are becoming increasingly sophisticated and efficient. SIAR occupies the last tier of the control process, conferring the official stamp on the whole organization.

APC With Missile Battery



Mirage 2000 Checkout

THE DIRECTION DES PERSONNELS ET DES AFFAIRES GENERALES (DPAG)

MISSION

Act on behalf of the Delegue General pour l'Armement in matters concerning staff and workforce, and general organization and administration.

FUNCTIONS

Prepares and implements the DGA budget for wages, salaries and employers' contributions in terms of staff strength and costs.

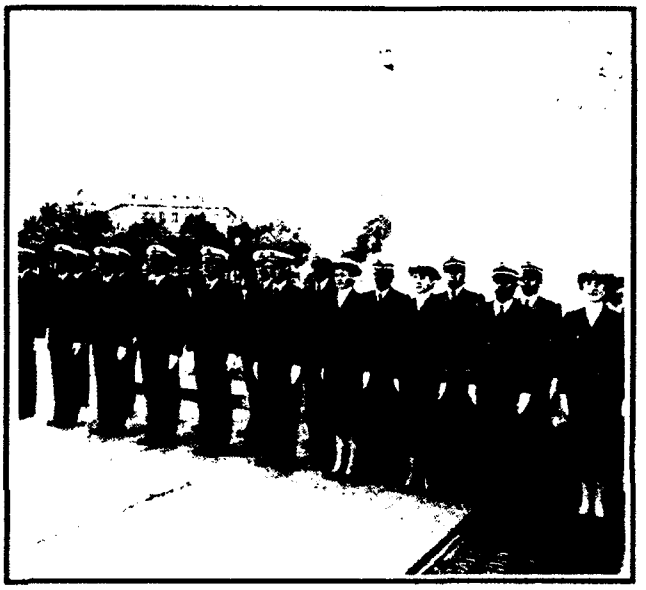
Takes part in preparing new legislation and regulations relevant to DGA.

Takes charge of matters of an administrative and legal nature, and of disputes concerning DGA both nationally and internationally.

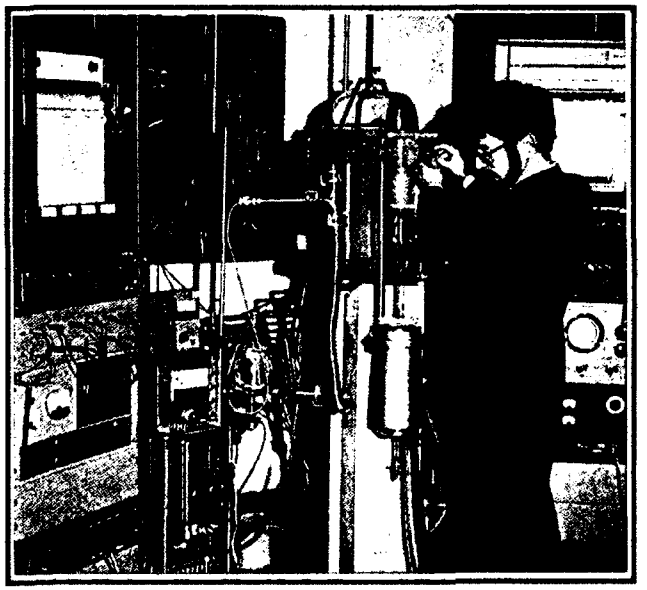
Advises the Delegue General pour l'Armaments on copyright and patents policy and executes the relevant decisions.

Submits policy recommendations regarding all levels of staff training for DGA military and civilian personnel. Prepares and implements adult training courses on general subjects for DGA executives (including higher military instruction), and deals with matters concerning DGA's stewardship on the Ecole Polytechnique.

Assists in drafting legislation and regulations concerning active and reserve military corps involved in armaments, prepares decisions on the individual management of the personnel in these corps, draws up career prospect policy, prepares plans for the recruitment and administration of civilian armaments personnel, and insofar as other staff Directorates and Departments are responsible, generally manages all the DGA's civilian staff.



Staff Inspection



Engineer Training

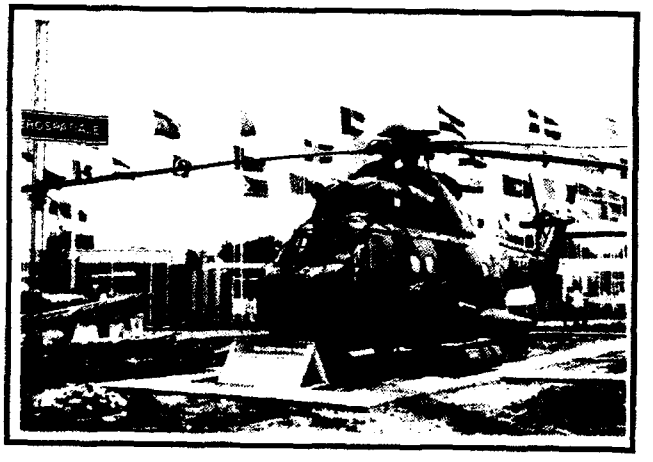
DELEGUE AUX RELATIONS INTERNATIONALES (DRI)

MISSION

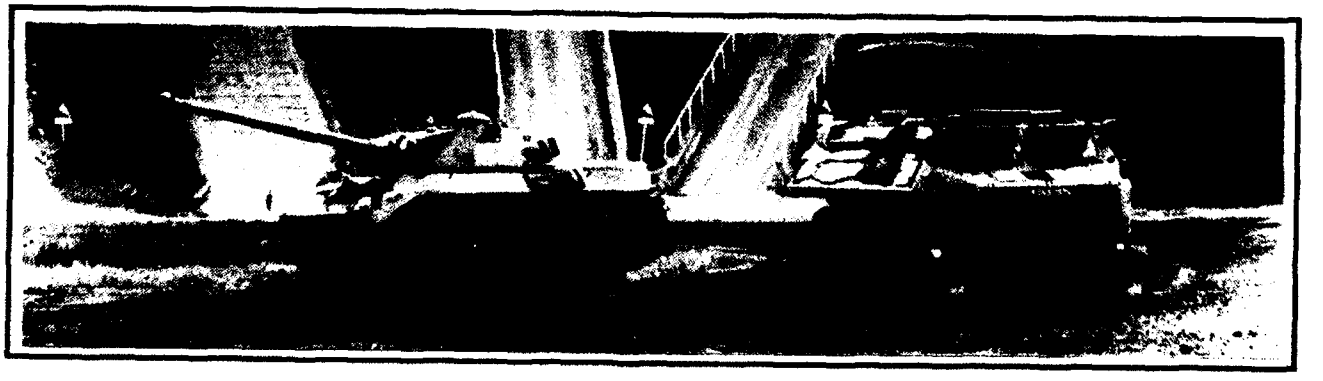
Manage matters concerning international cooperation in the armament domain and the export of defense systems and associated services.

FUNCTIONS

The DRI represents the MoD for all activities related to the control of international trading applicable to war equipment and assimilated products. It elaborates the cooperation policy, works out programs and the negotiation of corresponding agreements, and coordinates the action of governmental bodies with that of public or private firms taking part in cooperation activities.



Potential Foreign Military Exchange Equipment



France

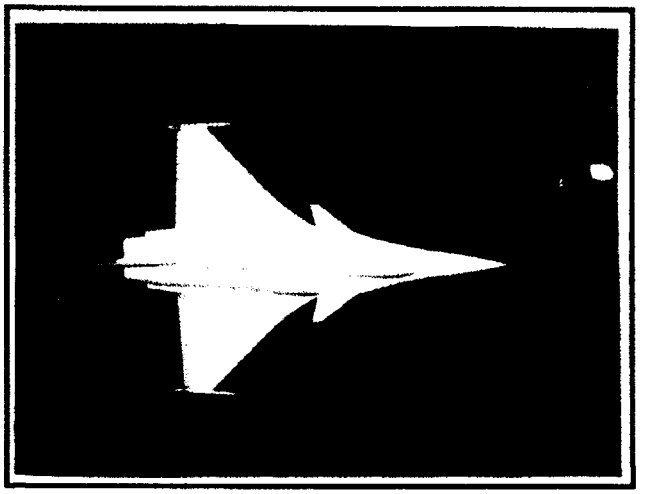
DELEGUE AUX PROGRAMMES D'ARMAMENT (DPA)

MISSION

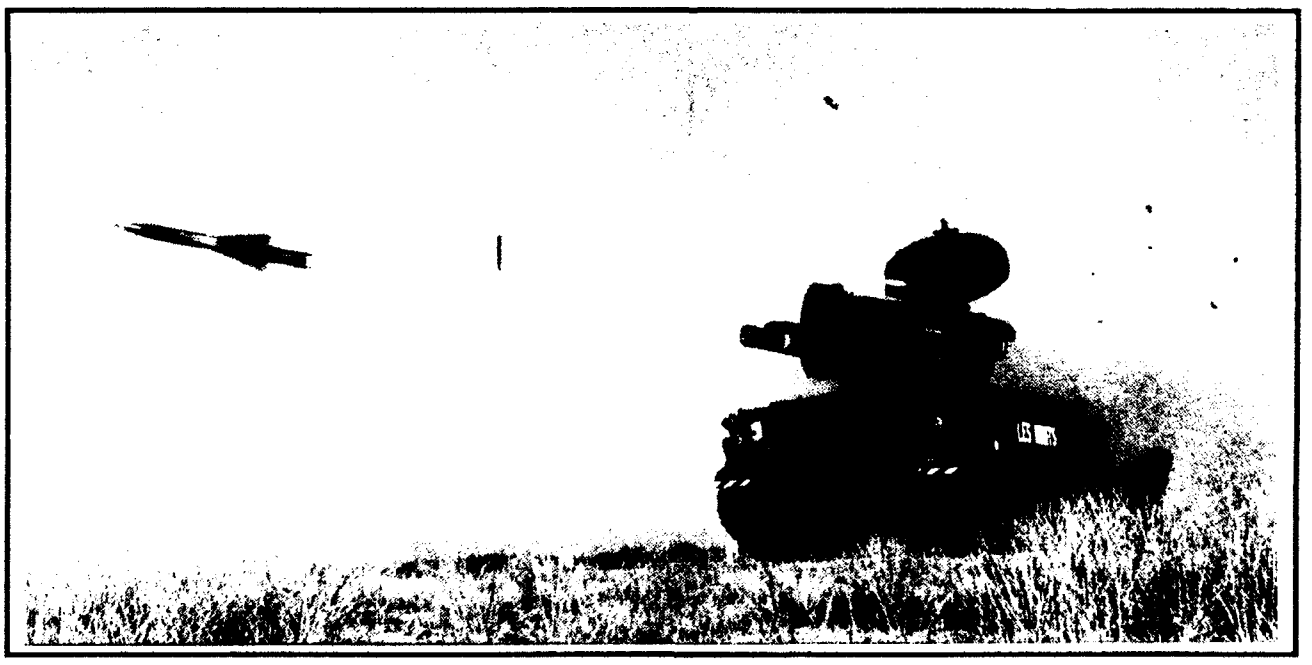
Direct and supervise the preparation and execution of research, design and manufacturing programs for the Armed Forces, on behalf of the responsible DGA Directorates.

FUNCTIONS

The Delegue aux Programmes d'Armament oversees the DGA in the domains of planning, programming, budgetary preparation and execution, elaboration of financial plans, program laws and yearly budgets.



Model inWind Tunnel



Surface-to-Surface Missile Test

DIRECTION DES RECHERCHES, ETUDES ET TECHNIQUES (DRET)

MISSION

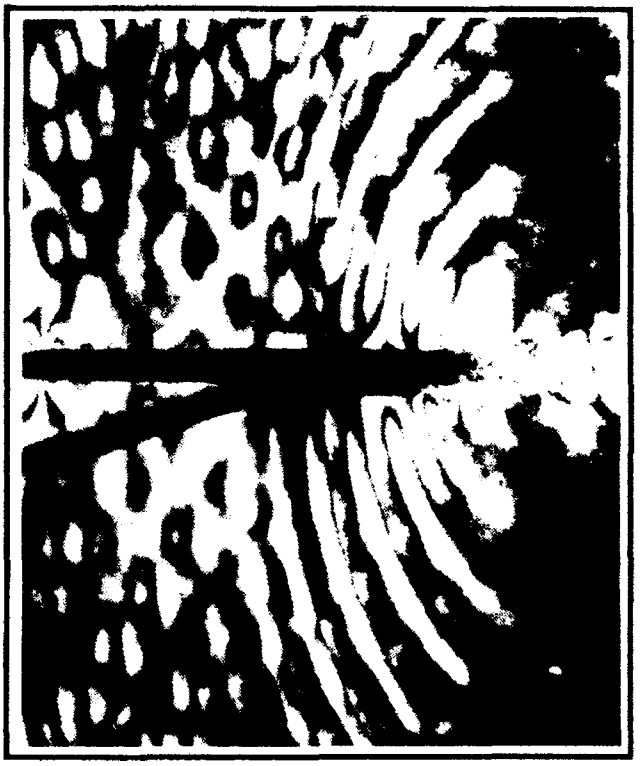
Supervise armaments related research and development for the Ministry of Defense (MoD). Responsible for all aspects of research upstream of development.

The DRET acts as an input point and guide for laboratories and enterprises, researchers, industralists and for all else who wish to collaborate with MoD.

Within the DGA, the DRET provides the means to establish the dialogue between the country's scientific and experimental circles and the Armed Forces. Its task is to follow up and promote the maturation of research concepts at the laboratory stage and convert such concepts into innovations which may be applied in the development of future National Defense weapon systems.

ESTABLISSEMENT TECHNIQUE CENTRAL DE L'ARMAMENT (ETCA)

Within the DRET, the ETCA is comprised of five autonomous centers for specific missions plus the laboratories and installations at Arcueil, Cazaux. and Gramat. The five centers are:



Hydrodynamic Testing

Le Centre D'Analyse de Defense (CAD) at Arcueil. Conducts operational research, modeling and simulation for evaluation of current and prospective future employment and logistical support of armaments.

Le Centre D'Etudes de Gramat (CEG) at Gramat. Conducts analyses of explosions and vulnerabilities of military systems.

Le Centre Mechanique-Chemic Materiaux (CMCM) at Arcueil. Conducts research of the of chemical materials.

Le Centre De Defense Nucleaire, Biologique et Chimique (CNBC) at Cazaux. Conducts research for nuclear, biological and chemical defense.

Le Centre des Techniques des Mesures et Moyens D'Essais (CTME) at Arcueil. Develops and analyzes standard techniques for measurement, recording,

exchange and evaluation of weapon systems data.

CENTRE DE DOCUMENTATION DE L'ARMAMENT (CEDOCAR)

MISSION

Maintain a scientific and technical information center whose works are available to DGA, the Armed Forces, public sector bodies and private companies with MoD clearance.

POINT OF CONTACT

Direction des Recherches, Etudes Et Techniques (DRET)
Postal Address and Offices
26 Boulevard Victor, 75996 PARIS ARMEES
Tel: (1) 45.52.56.75

Solar Concentrator Laboratory

DIRECTION DES ARMAMENTS TERRESTRES (DAT)

MISSION

Manage the design, technical testing and production of weapon systems and equipment for air/land warfare capability.

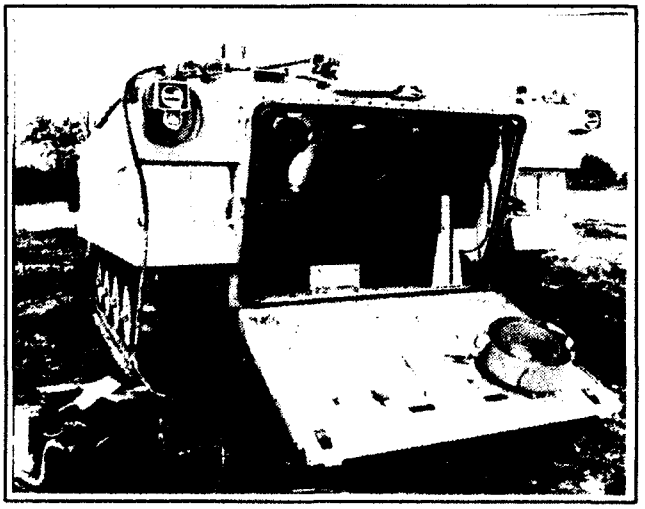
LOCATION

DAT central administration in Paris is supported by four specialized technical/test centers: ETAS (Angers), ETBS (Bourges), ETAS (Angers), CAP (Toulouse) and the SEFT, section d'Etudes et Fabrication des Telecommunications, (Fort Issy les Moulineaux).

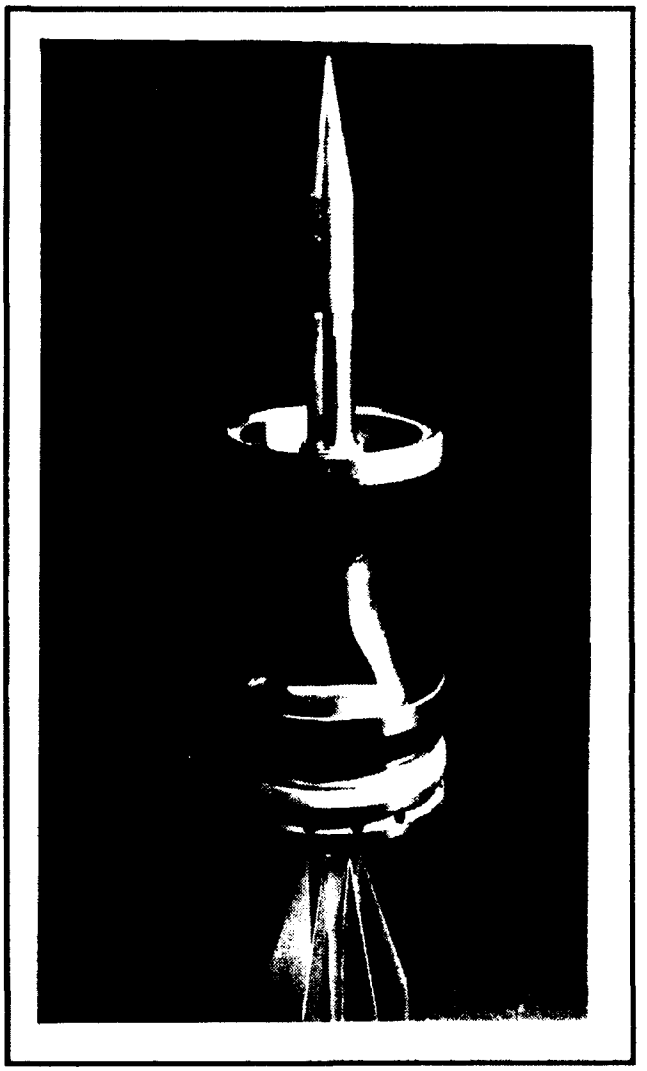
CAPABILITIES

The Establishment Technique de Angers (ETAS) is responsible for the design and testing of land and aquatic mobility systems/vehicles.

The Establishment Technique De Bourges (ETBS) is responsible for the design and testing of guns and ammunition.



Armored Personnel Carrier



Projectile with Sabot

The Center Aeroporte de Toulouse (CAP) is responsible for the design and testing of air transport and air-ground delivery and packaging.

The Section d'Etudes et Fabrication de Telecommunications (SEFT) is responsible for the French Army C^3I equipment and electronics systems.

POINT OF CONTACT

Director des Armements Terrestres
Centre Sully
10, place Georges Clemenceau

France

ESTABLISHMENT TECHNIQUE D'ANGERS (ETAS)

MISSION

In preparation for future contingencies in the field of land and aquatic mobility, manage development programs and evaluate equipment.

LOCATION

Ten km northwest of Angers at Montreuil-Juigne.

CAPABILITIES

Topography:

. ETAS stretches over 380 acres where all of the service plants, testing installations and support facilities are grouped.

ETAS has at its disposal a 7.5 acre sheltered harbor along the riverbank for its aquatic activities.

Facilities:

Its combined resources enable the Testing Center to evaluate the behavior and performances of vehicles by means of:

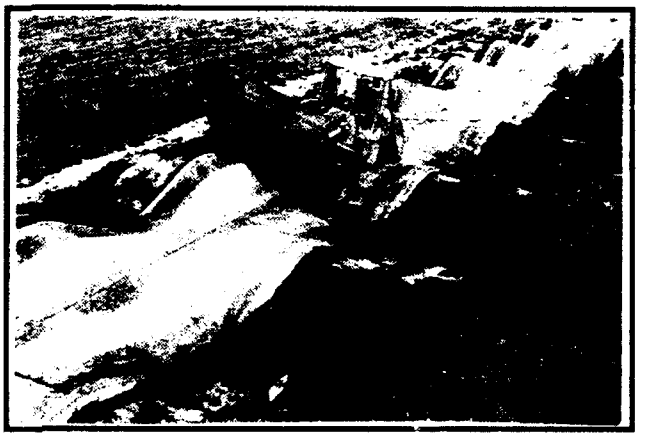
Tests of completed equipment at various stages of their development and in particular within the scope of equipment follow-up: functional scale-models, prototypes, pre-series and series.

Preliminary tests performed on the components of vehicles and completed vehicles.

Speed and braking test track, effective length: 1600 meters.

Closed road-circuit, 7 meters wide and 2900 meters long.

Complex of special tracks: distortion, sinusoidal, corrugated sheet metal, potholes for wheeled and tracked vehicles, obstacles, sharp embarkments, jumping boards.



Test Tracks

Harbor on the Maine river bank (currently used for tests).

Two all-purpose tracks on clay grounds.

Dynamometric vehicles which can apply resistance stress to traction vehicles and record all of their parameters.

Concrete and dirt ramps with inclines from 19% to 60%.

Tilting platform for stability tests (70 metric tons, up to 100%).

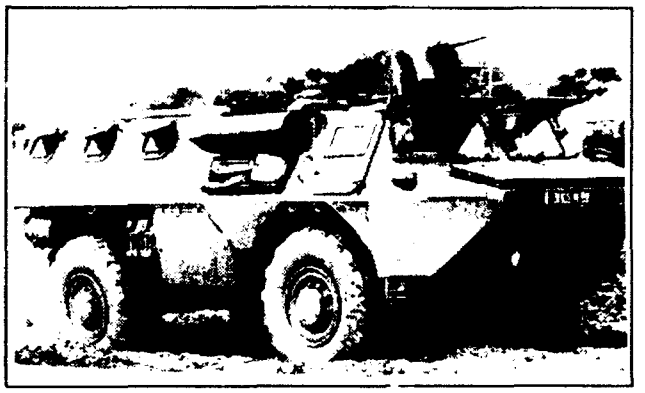
Components.

Engines and transmissions. Testing of thermal engines, outboard propellers, transmissions, motor-propeller groups, whether integrated or not into a machine. Engine powers treated in this testing platform range between just a few horsepower to two thousand horsepower (from a small generator to an armored tank).

Hydraulic components. The activities of this testing platform are directed mainly towards the evaluation in terms of performance and endurance of hydraulic powered systems and components.

Suspension and brake components. The suspension testing bench, which is unique in the NATO countries, has been specially designed for testing of tank components: shock absorbers, torsion bars, and elements of hydraulic suspension. In addition, it can be used as a means of testing low-frequency environmental vibrations. The brake testing bench has been designed to test the entire range of brakes on land vehicles, from a light vehicle to an armored tank.

Electrical components. The main activity of this testing platform revolves around certification testing of military electrical equipment: battery accumulators, lights, starters, generators, etc.



Armored Personnel Carrier

Resources:

In order to meet the requirements of the various component testing platforms and of the completed vehicle service departments in particular, the "Measures" Department provides the following services:

Determination of measuring gauges and of the resources to be brought into operation.

Acquisition of physical scales, analyses and related data processing.

POINT OF CONTACT

Etablissement Technique D'angers
Route de Laval
49 460 Montreuil - Juigne
BP. 4107-49041 ANGERS CEDEX
Telephone: 41.93.69.99

France

ESTABLISHMENT TECHNIQUE DE BOURGES (ETBS)

MISSION

Prepare for the future of land and air combat.
Conduct armament programs.

LOCATION

Near Bourges in the heart of France, 22km south of Paris and 280km west of Lyon.

CAPABILITIES

Topography: Generally flat rural area of 25,000 acres, 30km long. Three other sites support ETBS for specific needs.

Ranges:

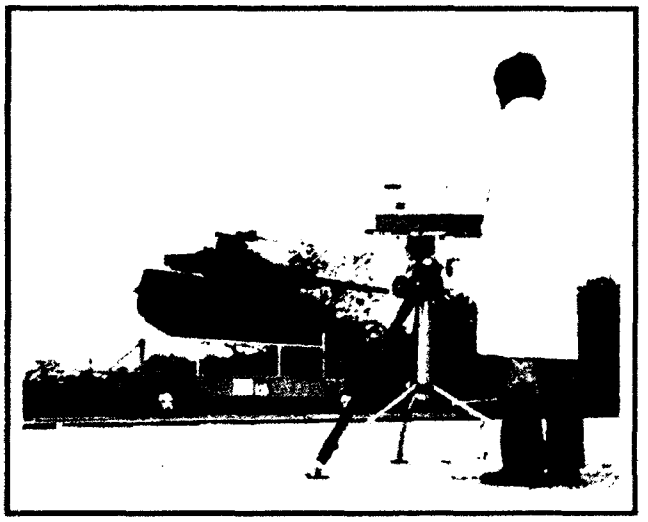
Captieux (Southwest France) - testing of main battle tank's ground firing on the move against mobile tanks.

St. Pierre, Quiberon Bay (Brittany) - long range firings to sea.

Valence (South France) - helicopter-mounted weapons tests.

ETBS is one of the main European test centers for ground -to-ground and air-to-ground weapon systems and their ammunition. The proving ground is quite unique because of the size of the facility, the quality and the quantity of available equipments and the competent human resources.

The appropriate facilities and know-how are available to carry out firing tests in tunnels and fields including internal and external ballistics tests, trajectography measurements, terminal effectiveness and detonation tests. Tests simulating climatic, mechanical, electromagnetic and nuclear environments can also be carried out. The main task is to carry out the technical tests contributing to the official evaluation of materiels by the Direction des Armements Terrestres (Army Weapons Directorate) before they are adopted by the Army Chief of Staff. Many tests are carried out on behalf of manufacturers, as well as acceptance and ammunition surveillance tests.



Moving Target Simulator

The firing range of ETBS in Bourges extends over 10,000 hectares. It includes about 60 firing tunnels and firing stations enabling all firing tests of small and medium calibre weapons, aircraft mounted weapons, large-caliber howitzers with ranges up to 25km, tank weapons, anti-tank rockets and missiles, mines, shaped-charge ammunition, APDS ammunition, or armor materiels.

Long range weapons can be fired either at the annex in Quiberon or in cooperation with the GERBAM in Gavres or with the "Centre d' Essais de la Mediterranee" on the Levant Island.

ETBS operates a specific facility in Captieux in the Landes Forest to carry out development and evaluation tests on fire control systems of future main battle tanks. The tests allow tanks to fire on the move against moving targets both in actual and simulated firing modes.

Facilities:

Large storage facilities accommodate powder explosive and ammunition lots in safe conditions.

Accurate calibration devices required for qualifying measuring systems and calibrating sensors. The measuring systems use computer-processing techniques that enable the simultaneous analysis of many parameters in real time or with a short delay. They also enable simulations.

The Test Center is provided with the means and specialists to acquire and process data from a dozen simultaneous separate tests. During each test, one or more of the following parameters can be measured:

Internal ballistics: pressure and temperature measurements and thermovision.

External ballistics: measurements of projectile velocities at the muzzle and at the target by means of optical gates or continuously, by means of Doppler radars; measurement of aerologic parameters at ground level and up to a 20,000m altitude.

Terminal ballistics: observation of the effect of APDS ammunition or shaped-charge ammunition on the target, using flash X-rays (exposure time:30 nanoseconds).

Environment of weapons systems: measurements of displacements, vibrations, strains and accelerations, impulses imparted to the crews, noises and shock wave pressures, flash phenomena and smoke.

TheTest Center is equipped with systems for visualizing ultrarapid phenomena. Besides flash X-ray systems, high speed cameras (up to 20,000 images/second and rapid videography systems (up to 200 images/second) enable the observation of projectiles and missiles attitudes along their trajectory.

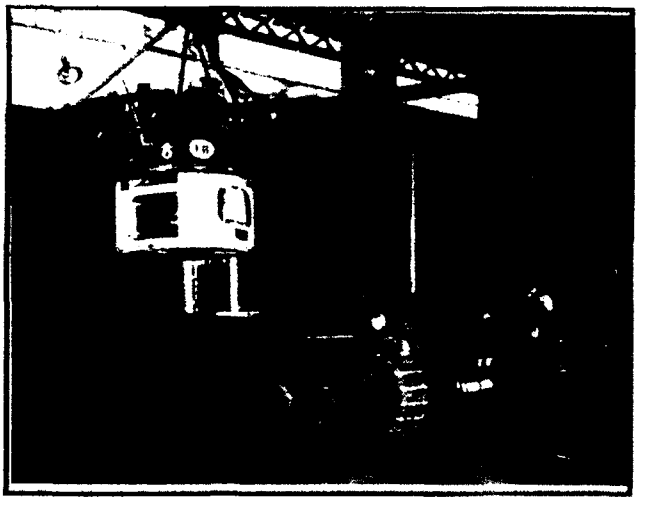
Cinetheodolites used in conjunction with trajectory data processing devices and automatic infrared tracking systems enable the ETBS to plot the trajectory of anti-tank missiles.

The Test Center is provided with high performance environment simulation facilities: two large climatic chambers able to accommodate complete vehicles at temperatures varying from -60°C to +70°C. One of these rooms equipped with a wind tunnel is able to simulate wind with a velocity up to 140km/h.

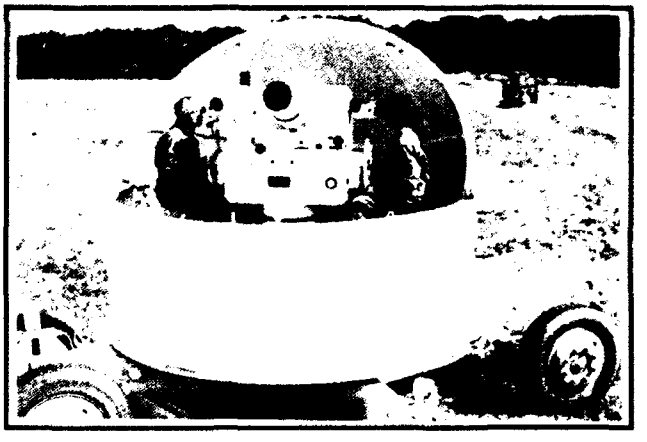
A mobile climatic unit for testing artillery weapon systems at various temperatures on firing ranges.

A climatic and mechanical environment simulation facility enabling testers to carry out any environment simulation test on pyrotechnical items.

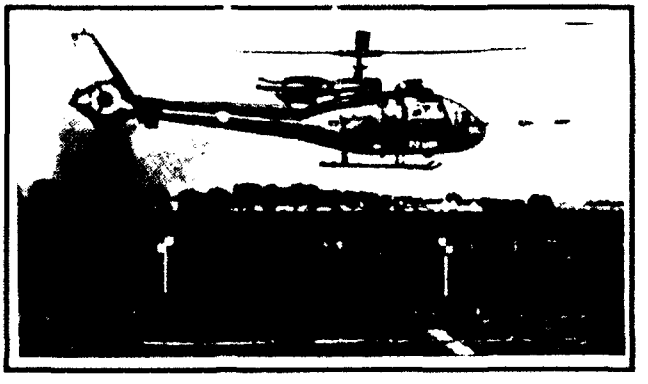
A nuclear decontamination and protection facility, unique in Europe, capable of evaluating the contaminability of materiels and capable of defining decontamination procedures.



Loading Tank Gun

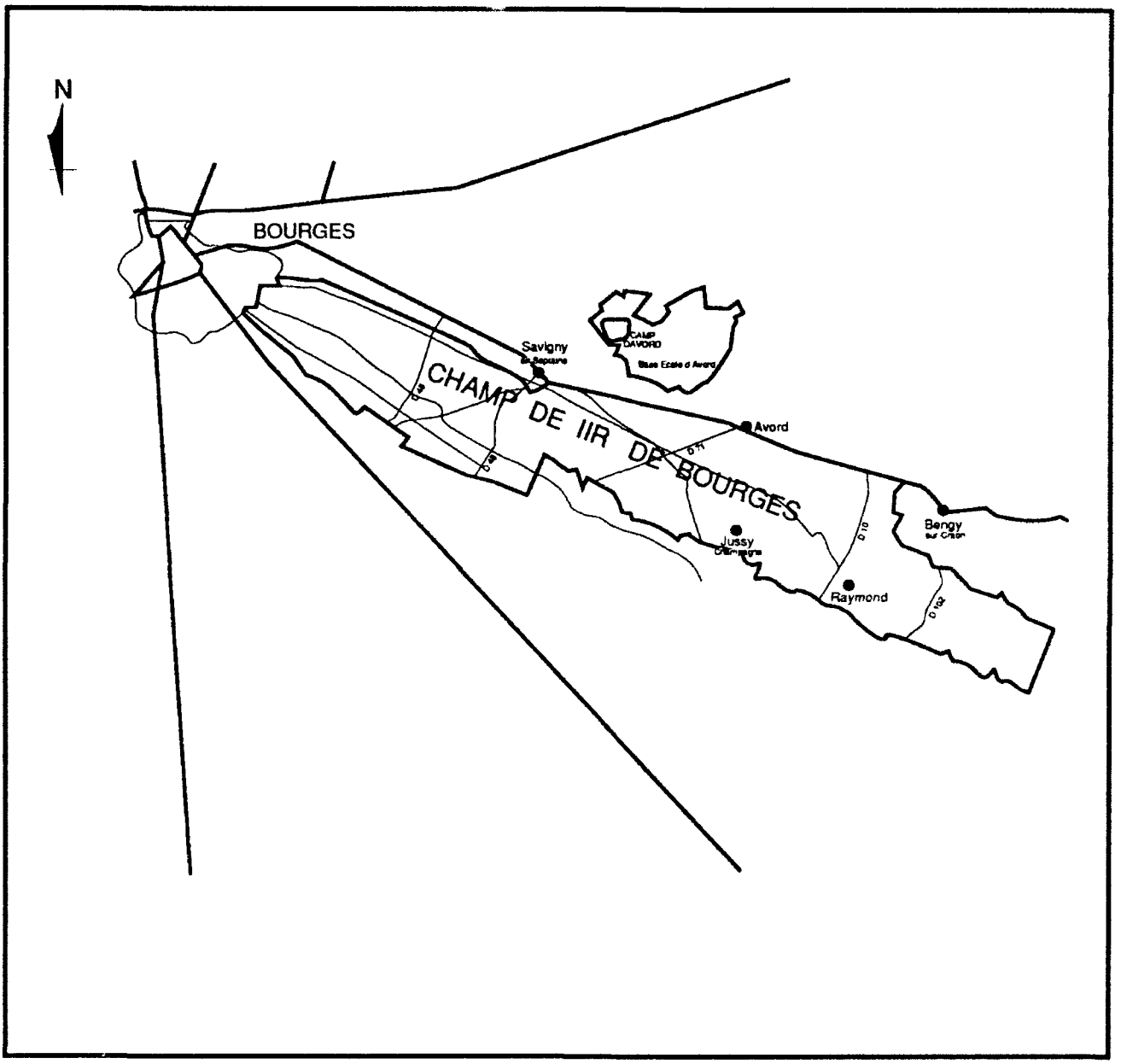


Tracking Telescope



Air -to-Ground Missile Test

France



ETBS Firing Range

CENTRE AEROPORTE DE TOULOUSE (CAP)

MISSION

Technical Center - Direct Air Mobility Programs.
Test Center - Perform T&E requested by the Technical Center.

LOCATION

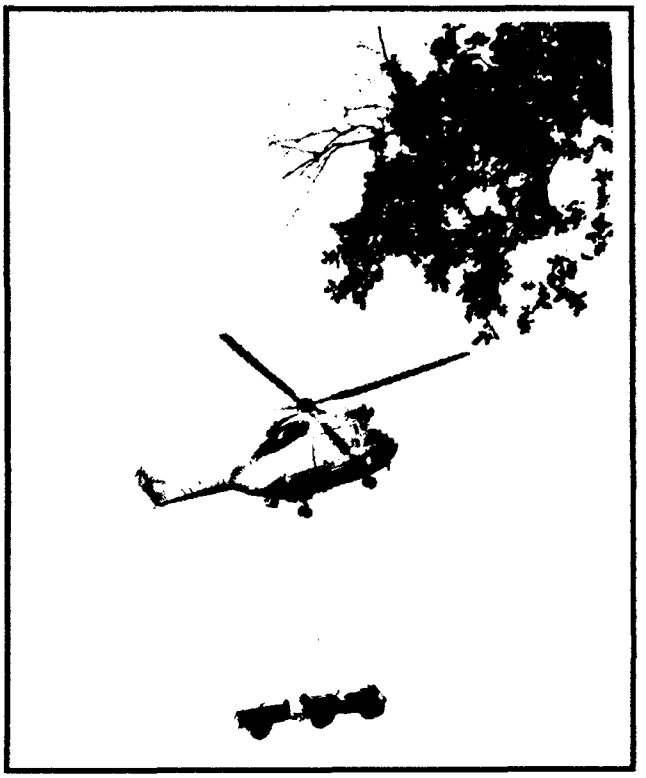
At Toulouse, Southern France.

CAPABILITIES

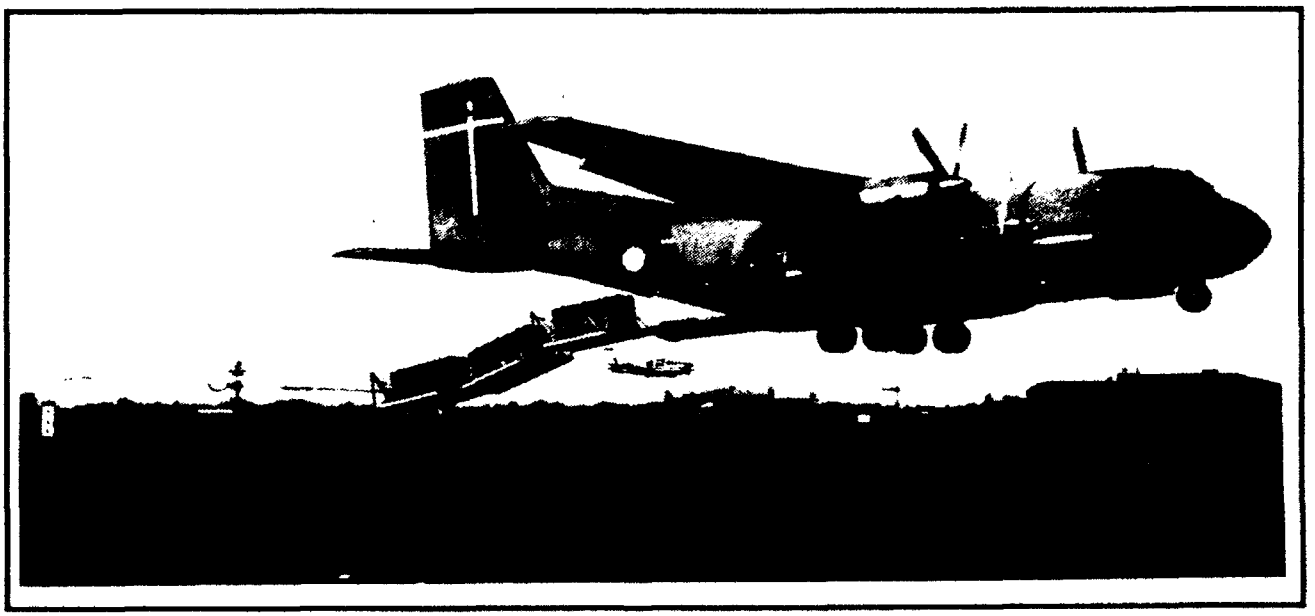
Aircraft and observation/recording capabilities to test and evaluate air dropping of personnel, air dropping of equipment, airborne transport, helicopter transport, and packaging.

POINT OF CONTACT

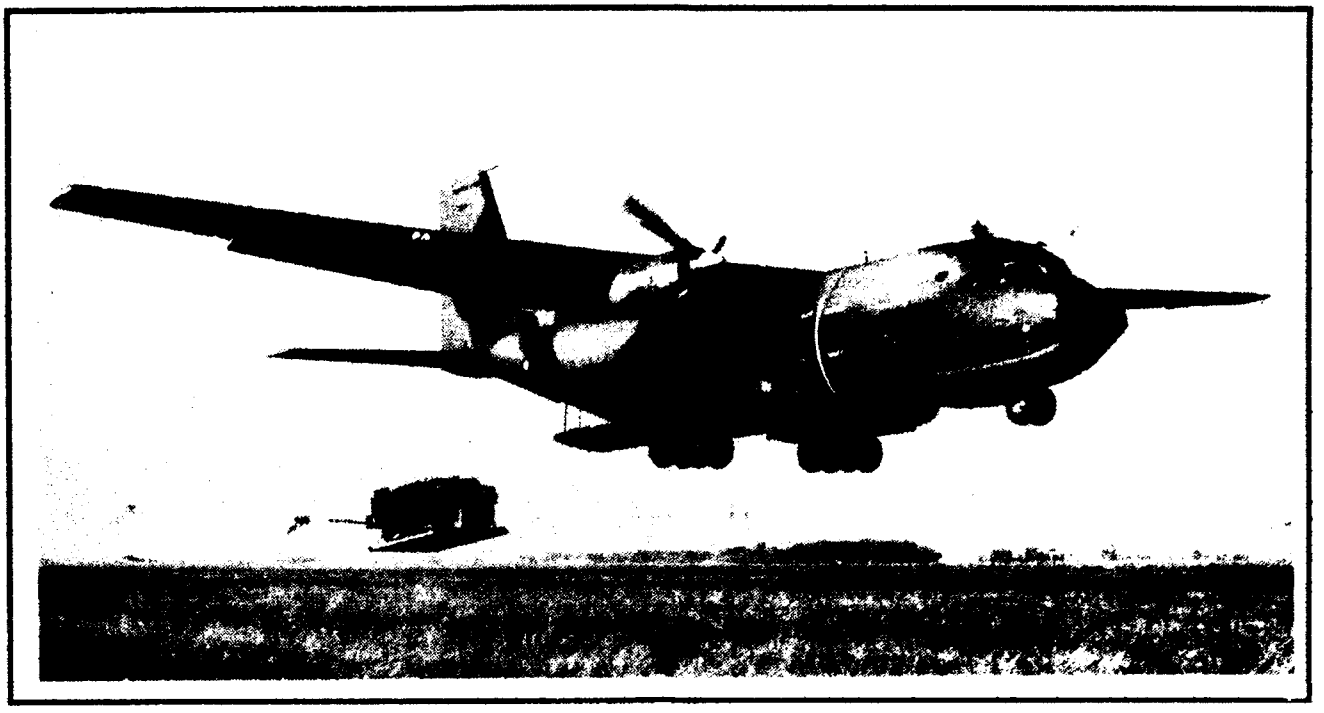
Centre Aeroporte deToulouse
155 Avenue de Grande BretF - 49F - 49agne
31052 TOULOUSE CEDEX
Telephone: 61.31.38.38



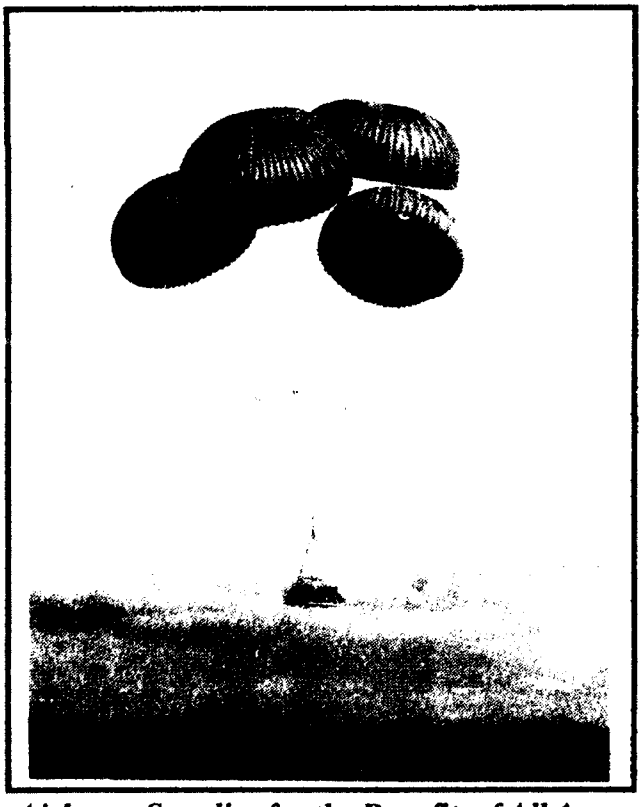
Air Borne Transport of Equipment



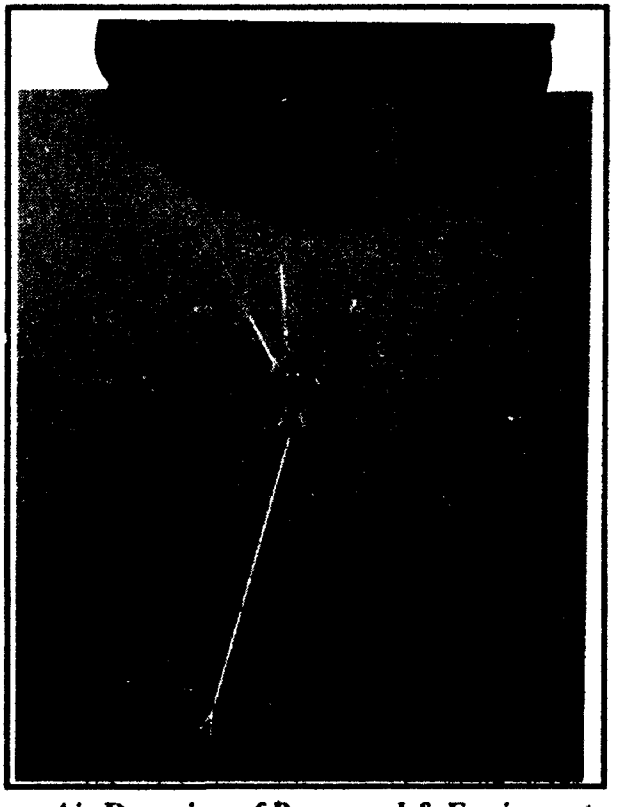
Classic Air Dropping of Equipment (Gravity Ejection)



Air Dropping at Low and Ultra Low Altitudes.



Airborne Supplies for the Benefit of All Arms



Air Dropping of Personnel & Equipment

SECTION D' ETUDES ET FABRICATIONS DE TELECOMMUNICATIONS (SEFT)

MISSION

Satisfy the requirement of the French Army for electronic equipment and systems (hardware and software).

LOCATION

At Fort Issy-les-Moulineaux, south of Paris.

CAPABILITIES

SEFT ensures implementation of the programmes through contracts with private industry, from design to after-sales services.

SEFT prepares for the future by "upstream" involvement in the production circuit, i.e., design, study, and exploratory development, and by intensive participation in all international and national meetings.

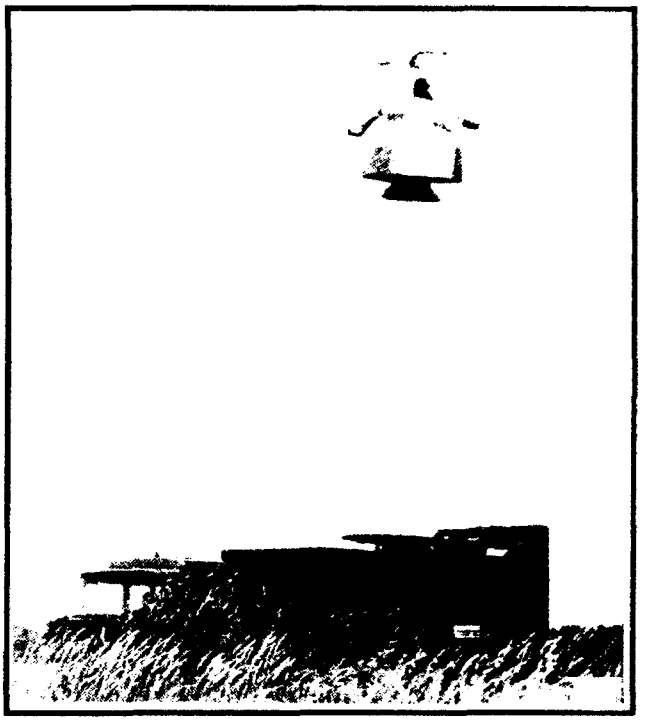
It has available considerable personnel (over 100 engineers) and material facilities for conducting high performance tests.

Facilities:

In addition to conventional facilities comprising electronic metrology and spectographic measuring equipment, the SEFT has a calibration laboratory officially cleared for level 4 quality (of which there are only about 10 in France) by the Bureau National de Metrologie. This laboratory combines high precision control standards (frequency 10^{-11}, AC voltage 10^{-4}, DC voltage 10^{-5}, and ohmic resistance 10^{-6}).

Reference test rigs enable the necessary verifications to be made to satisfy the requirements of the SEFT in its capacity as expert.

Scientific for the various departments of the establishment.



ARGUS

Management for SEFT and for the DTAT as a whole (for study and operation of applications and administrative systems).

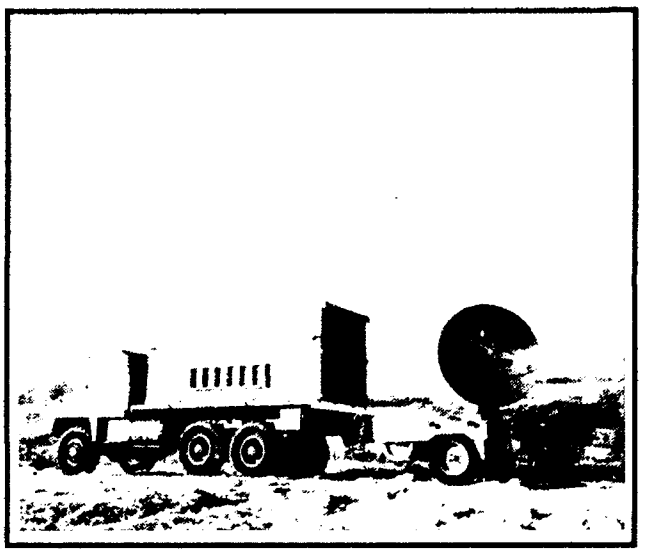
A large dimension tunnel (110 x 6 m) for verification of equipment, night vision in total darkness or adjustable residual elimination down ot a level of 10^{-7} LUX.

An optical measuring bench that is unique in France, for measurement of the transfer function, optical systems, tubes and complete units.

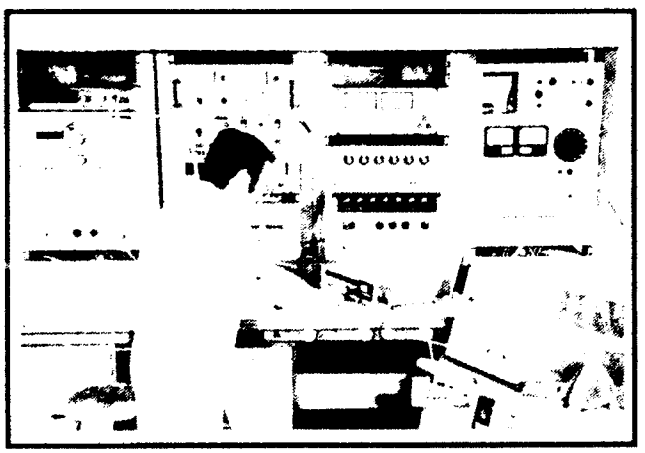
France

A 120 m³ high preformance Faraday cage: attenuations of 100 dB at 1 MHz and over 85 dB at 1 GHz equipped with an automatic measuring bench (acquisition plus recording) covering the range from 28 Hz to 1 GHz.

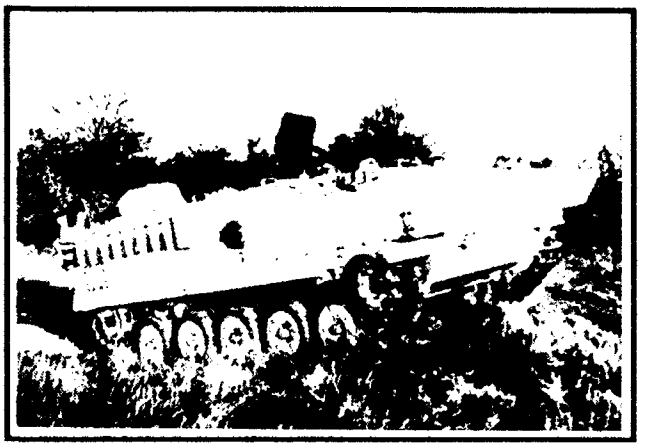
A vast 1,200 m³ (14 x 14 x 6M) Faraday cage capable of accommodating the largest equipment complete with motors that are running. This cage has a performance equivalent to the previous one and is intended for verifying the interference suppressors and electromagnetic compatability of all vehicles, armored equipment and weapon systems. It is provided with a Hewlett-Packard automatic test bench for very fast acquisition and testing of measurements, permitting exhaustive in-depth research.



Sirocco Metorological Probe



Calibrating Laboratory



RATAC Artillery Radar

As many as 200 logic and analog signals can be sent simultaneously by means of a mobile measuring centre capable of data recording and analysis using a Hewlett-Packard computer.

The SEFT has the necessary installations for publishing all instructions, support and repair manuals.

TYPICAL PROJECTS

LODXOR Electronic Scanning Research Center
THERMIDOR Infrared Camera
TELECOMMUNICATIONS Systems
CECORE Network Control Center
OLIFANT Portable Infantry Radar
RASIT Reconnaissance Radar
RATAC Artillery Radar
ORPAEE Observation Radar for Captive Airborne Platform
EW Systems

POINT OF CONTACT

Section d'Etudes et Fabrications des Telecommunication
18, rue du Dr. Zamenhof
Fort d'Issy - Issy les Moulineauz - 92131
(France)
Telephone: 645 21 51
Telex: 260 000

CENTRE D'ETUDES DE GRAMAT (CEG)

MISSION

Research the parameters of explosions in the field of terminal ballistics to improve the effectiveness of explosive warheads and increase the protection of military equipment.

LOCATION

The center is located on the site of a circular chasm in the countryside near Bedes, approximately 180 km east of Bordeaux in South Central France.

CAPABILITIES

Topography:

A natural chasm which provides a unique site occupying nearly seven hundred acres ideally suited for conducting firing tests.

Organization:

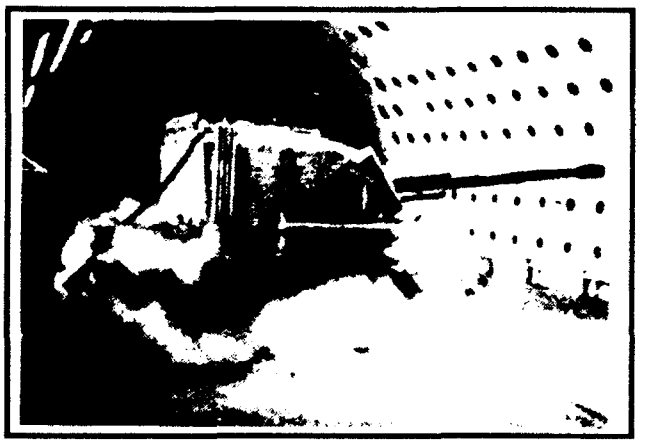
The CEG operates as an entirely self sufficient organization supporting many clients in manufacturing, public services, private and nationalized firms in addition to the Army and the Delegue General pour l'Armaments.

Weapons and Vulnerability Department has the mission to respond to the basic questions relative to the terminal ballistics of conventional weapons in order to improve the effectiveness of explosive warheads and to increase the protection of military equipment. TheDepartment:

- Assesses the behavior of materials submitted to high dynamic pressures using every means permitting the generation of shocks and precise measurement at the heart of materials.

- Studies methods to improve the efficiency of missile warheads.

- Assesses the vulnerability of and increases the protection of aircraft and flying targets.



Testing in a Large Blast Simulator (Interior View)

- Studies the effects of x-rays emitted by nuclear explosions in space from launched systems (missiles, re-entry vehicles, equipment casings, satellites, etc.)

Hardening Studies Department has the mission to assess the effects of nuclear weapons, to recommend proper hardening solutions and to validate these solutions through full-scale simulations.

- Studies and test means of protection.

- Studies effects of EMP on systems, circuits and materials at rest and in operation.

- Studies mechanical effects of nuclear explosions.

Facilities:

A dynamic press with axial thrust (300 tons in 2.6 milliseconds).

A Demeter cannon of compressed gas, with alignment of target by laser.

Powder cannon.

Electro-magnetic and piezoresistive high resolution probes (20 to 100 nanoseconds).

Doppler laser interferometer.

Firing areas equipped with instruments for experiments with military warheads.

Powder cannons projecting fragments of 0 to 10 grams at speeds of between 0.2 and 2.4 km per second.

Experimental simulation: 6 firing areas equipped with X-ray and high speed cameras, electronic chronometers, Doppler laser interferometers and Lagrangian metrology.

Implementation of explosions: the CEG has a manufacturing unit producing different types of explosive samples to supply the firing areas.

Numerical simulation: a computer service for scientific calculation with a graphic output display which allows extrapolation of results.

A high-performance scientific computer.

Numerical and graphic consoles.

Plotter and COM (Computer Output Microfilm), alpha mode and graph mode.

Electron generators for the themomechnical effects and electro-magnetic fields in cavities.

X-ray generator for X-ray effects on materials and components.

Simulation: nuclear EMP simulators capable of creating fields with vertical or horizontal polarization.

Means of measurement: high-performance mobile apparatus capable of operating anywhere in France.

Intensive flux generators.

Large blast simulator (SSGG). The SSGG has the capability to generate realistic basic features of a nuclear blast wave, namely:

- the static overpressure,
- the static overpressure impulse, and
- the dynamic pressure impulse.

The simulated nuclear weapon yields range from 5 KT to 1250 KT corresponding to a 1500 m to 2500 m range of distances from ground zero. Inside this range, the expected static overpressure may vary from 15 to 140 kpa and the maximum winds from 120 to 820 km/h.

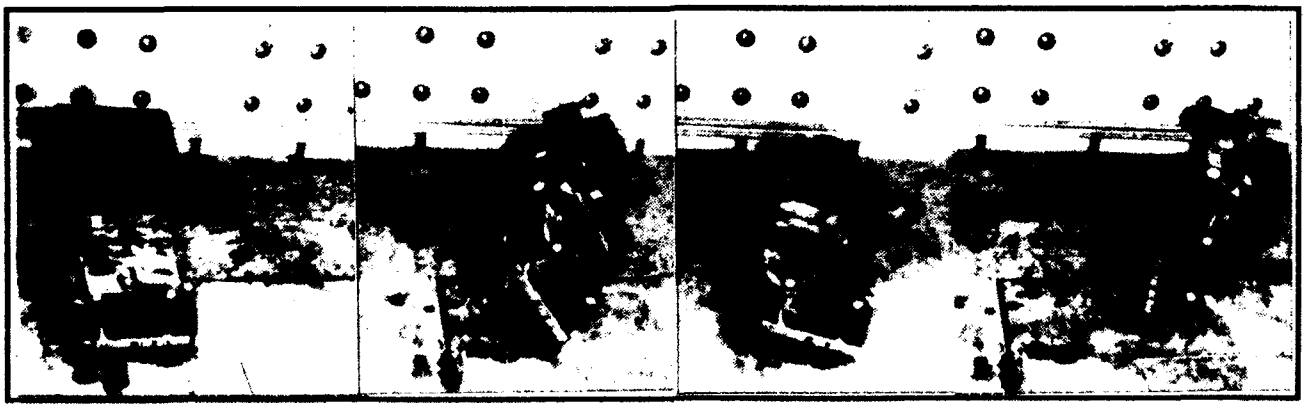
The broad simulation range of SSGG admits a wide range of damage levels to the equipment tested, beginning with light damage and progressing to severe damage. This damage range can be realized against equipment as hard as a heavy battle-tank.

In order to calculate the parameters of the simulated nuclear blast for each shot, pressure gages are installed along the tunnel to record the static and dynamic overpressures.

In order to analyze the behavior of the equipment tested a variety of transducer instrumentation can be used to measure:

- pressure,
- acceleration,
- displacement, and
- stress-strain.

A recording unit permits the simultaneous monitoring of



The high speed motion picture shows the behavior of the vehicle while being overturned by a shock wave

65 channels with a 10 khz to 80 khz bandwidth.

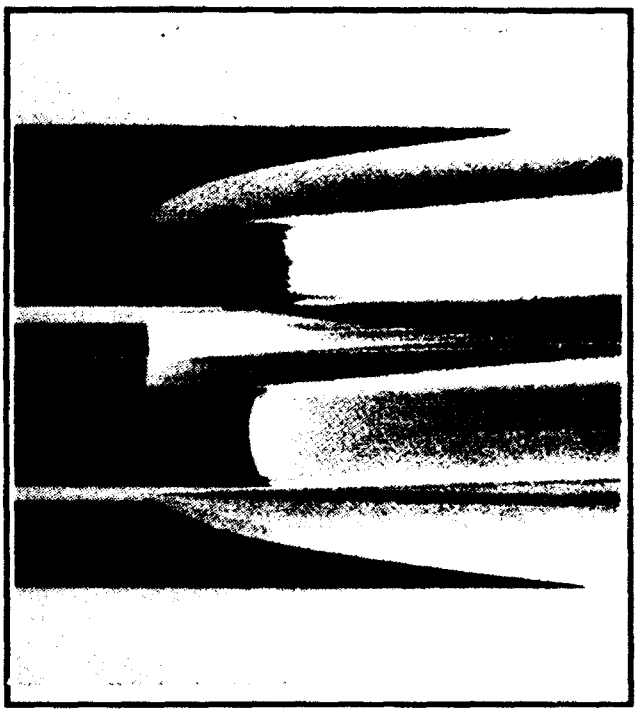
High speed motion picture cameras (16 m/m - 500 fps) monitor the gross behavior of the tested equipment during the blast gust.

Instrumented anthropomorphic dummies seated at the work stations of the equipment permit the response analysis of crew behavior.

A data reduction system permits the analysis of all the recordings. From gathered data, these basic features are extracted:

- peak-values,
- mean values,
- impulses,
- durations, and
- vibration frequencies.

The analysis leads to understanding of the damage which is then photographed in order to prepare a preliminary shot report. A final technical report is prepared including all data collection and reduction along with a motion picture document. For instance, a shot series aimed at detecting the "Achilles heel" of a light armored vehicle requires roughly 10 shots of increasing severity distributed over a 1 to 2 months period at the SSGG. At the end of that period, the program manager has all the necessary information in order to design the hardening fixes which will allow the vehicle to meet its military requirements.



Measuring the Speed of a Shockwave (Streak Camera)

POINT OF CONTACT

Direction des Recherches, Etudes et Techniques
Sous-Direction NBC
26, bd Victor. 75996 PARIS ARMEES
Telephone: (1) 45.52.46.38

Centre d'Etudes de Gramat
46500 Gramat
Telephone: 65.38.73.70

France

DIRECTION DES CONSTRUCTIONS NAVALES (DCN)

MISSION

Provide design, construction, rigging, testing, maintenance, adaptation and modernization of the fleet vessels and their weapons systems.

LOCATION

The DCN has about 30,500 employees, divided between the following locations:

Directorates located in the French Atlantic and Mediterranean shipyards (Cherbourg, Brest, Lorient and Toulon), the main function of which is the construction, rigging and servicing of the fleet vessels,

Establishments outside military ports (Indret, Ruelle, and Saint-Tropez) which are generally involved in specialist activities (propulsion systems, weapons systems, munitions),

One overseas base: Papeete,

One technical department (STCAN) and fourteen study testing and evaluation centers. The specific activity of each of the centers follows.

CAPABILITIES

The STCAN designs warships for the French navy and for export and defines preliminary studies up to the development stage. For this, it maintains the highest level of competence in the fields of naval architecture and combat systems design

Nuclear Attack Submarine

and uses the latest methods and techniques:

- Computer assisted design (CAD), and

- Construction of quality and safety.

The STCAN controls programs concerning combat and support vessels and weapons systems. It also plans and organizes logistic support (spare parts, tools, documentation).

The STCAN directs research and development in specific areas of military shipbuilding, mainly based upon the DCN Study Testing and Evaluation Centers.

It also conducts studies concerning the prospects of future threats and the organization and design of future systems.

In addition to its missions, the DCN is capable of carrying out various work of a burdensome nature for private companies or for foreign official organizations: naval construction and repair, high precision mechanical fabrications, sheeting, etc.

POINT OF CONTACT

2, rue Royal - B.P. 1
75200 PARIS NAVAL

Tel: (1) 43 60 33 30
Fax: (1) 45 54 06 89
Telex: 270 SCO DCN

Aircraft Carrier Refit

CENTRE D'ESSAIS ET D'EVALUATIONS

The surface combat ships or submarines that the DCN produces are likely to intervene in all areas of the world.

It is essential that the more recent techniques, technologies, equipment and weapon systems be put at the disposal of the naval combat ship architect, thus enabling him to design and manufacture a product which meets requirements. This is the aim of the activities undertaken by the DCN in its 14 Study, Test and Evaluation Centers.

BASSIN D'ESSAIS DES CARENES - PARIS. The Bottom Testing Tank (B.A.) conductS hydrodynamic tests and performs surveys concerning war ships, submarines and submarine weapons of the French, Navy. Being the only laboratory of this type in France, the Bottom Testing Tank also conducts tests and performs surveys concerning merchant ships and offshore rigs on behalf of private ship builders and naval engineering companies.

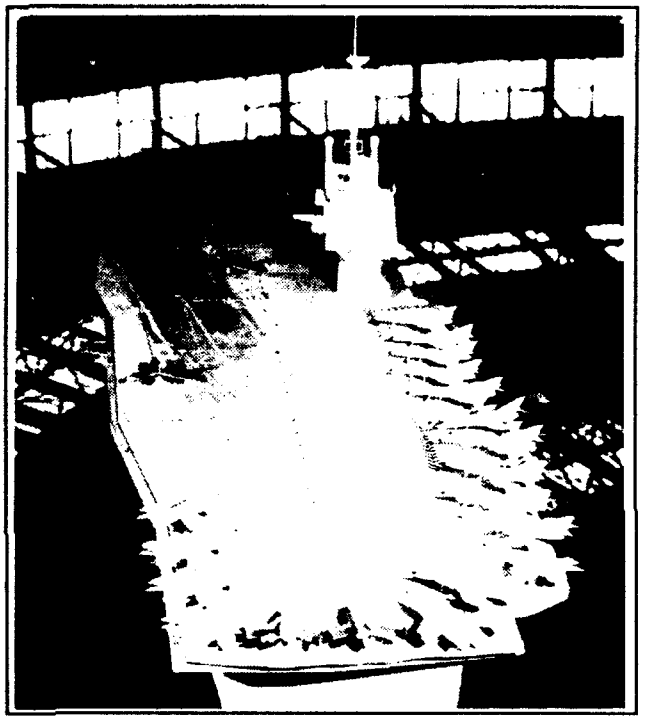
POINT OF CONTACT

For BASSIN D'ESSAIS DES CARENES
STCAN
8, Boulevard Victor
75732 Paris Centre 15- France
Phone: (1)40-59-14-00
Fax: (1)40-59-19-29

GETDL - TOULON. The Torpedo Group and Launching Management (GEDTL) of Toulon is in charge of developing the torpedo launcher tubes, managing torpedoes launching and sub-systems for missile launcher tubes of strategic submarines.GETDL is responsible for:

- the development of launch systems, testing and launching torpedoes, and tactical and strategic missiles.
- the MSBS missile launch system that launches two types of missiles, the SSL M20/M4 and the new generation SSL NG.
- the LAT tactical arms launching system used on all French submarines.
- the installation of the ILT torpedo launch system used on surface vessels.

GERDM - TOULON. The Submarine Detection Study and Investigation Group (GERDSM) of Toulon provides on the one hand submarine acoustic detection systems for surface ships, submarines, aircraft, and on the other hand takes part in the work intended for evaluating the detection and identification vulnerability of these ships. The Group is responsible for improvement of the processes of detection, localization, and identification of submarines.



Model Aircraft Carrier

CAPCA - TOULON. The Computation and Programming System Analysis systems analysis, programming, and calculations for the research and realization of integrated submarine command and control systems.

The Center is a dataprocessing and expert automation center devoted specifically to weapon system dataprocessing.

CESDA - TOULON. The Aircraft Defense System Experimenting Center (CESDA) of Toulon is in charge of the technical evaluation of weapon systems, anti-surface surveillance and electronic warfare systems.The Center is responsible for:

- lookout detection systems (radar, infrared),
- electronic warfare systems,
- AA armament systems, and
- integration of combat systems.

CERTEL - TOULON. The Center for research and studies on telecommunications is equipped with:

- turning platform with measuring antennas,
- two floating platforms for testing radio electronics,
- a platform with a surge simulator,
- a base for measuring electromagnetic compatibility, and
- two Faraday casings (Faradaic theories) used for testing low frequencies.

The Telecommunication Center is in charge of evaluating equipment or telecommunication and radiolocalization systems in an environment representative of the naval environment.

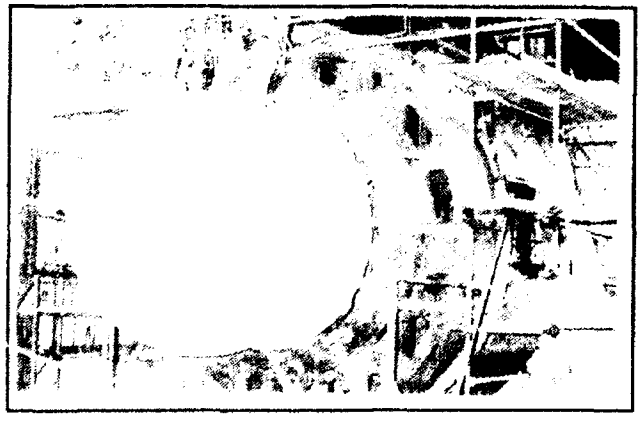
CERTSM - TOULON. The Submarine Technique Study and Investigation Center (CERTSM) of Toulon is in charge of work dealing mainly with the development of submarine exploration systems, salvage, localization, and refloating systems; recycling and control of the atmosphere and physiology and toxicology applied to life in a confined atmosphere. CERTSM areas of study are divided into four categories:

- Life in a Confined Atmosphere (elimination of pollutants and regeneration of the atmosphere).
- Materials for an individual life saving system for submariners.
- Intervention beneath the sea.
- Anti-corrosive paints

CERDAN - TOULON. The Ship Acoustic Discretion Study and Investigation Center (CERDAN) of Toulon deals with the improvement of the acoustic signature of ships. This center is responsible for testing:

- structural mechanics,
- acoustics,
- hydrodynamics,
- mechanical fluids,
- suspension systems, and
- materials that act as a shock absorber.

All of the acoustic testing is performed on experimental models.



A Panoramic Sonar Antenna

Exocet Test Firing

GERPY - TOULON. The Pyrotechnics Study and Investigation Group (GERPY) is in charge of pyrotechnical surveys and investigations concerning marine munitions.This group is responsible for:

- studies of the performance and methods of using powder and explosives above and beneath the sea,
- formulating and maximizing the pyrotechnic works with special effects,
- the studies of the effects of aging, stablizing, and compatibility of active substances.
- the effects of underwater explosions on structures, and
- the vulnerability of ammunition and weapon systems in combat.

POINT OF CONTACT

For GETDL, GERDSM, CAPCA, CESDA, CERTEL, CERTSM, CERDAN and GERPY

DCAN Toulon
Arsenal Maritime
83800 Toulon Naval - France
Phone: 94-62-90-00
Fax: 94-33-13-99

GERBAM - LORIENT. Ammunition, Weapon, Ballistic Survey and Investigation Group (GERBAM) of Lorient is in

charge of studying or checking the preservation of munitions as well as evaluating them with respect to safety, efficiency and vulnerability.

POINT OF CONTACT

For GERBAN
DCAN Lorient
Arsenal Maritime
56324 Lorient - France
Phone: 97-21-14-01
Fax: 97-21-12-14

CPAM/ST PARIS. The Marine Programming Center (CPAM/ST) is in charge of the dataprocessing integration of combat systems and system intended for ship control. Among others, this center produces the SENIT (Tactical Information Naval Handling System).

POINT OF CONTACT

For CPAM/ST
ECAN Paris
10, rue Sextius Michel - France
Phone: (1)40-59-53-33
Fax: (1)40-59-19-29

MSN - PARIS. The Naval Materials and Structure Group (MSN) is in charge of evaluating and quantifying the materials used or likely to be used in naval construction. This group also studies and defines the means for protecting such materials against corrosion and fouling; develops and applies experimental structural analysis methods; studies and promotes new construction procedures for hulls; and develops and applies structure calculation and design methods.

POINT OF CONTACT

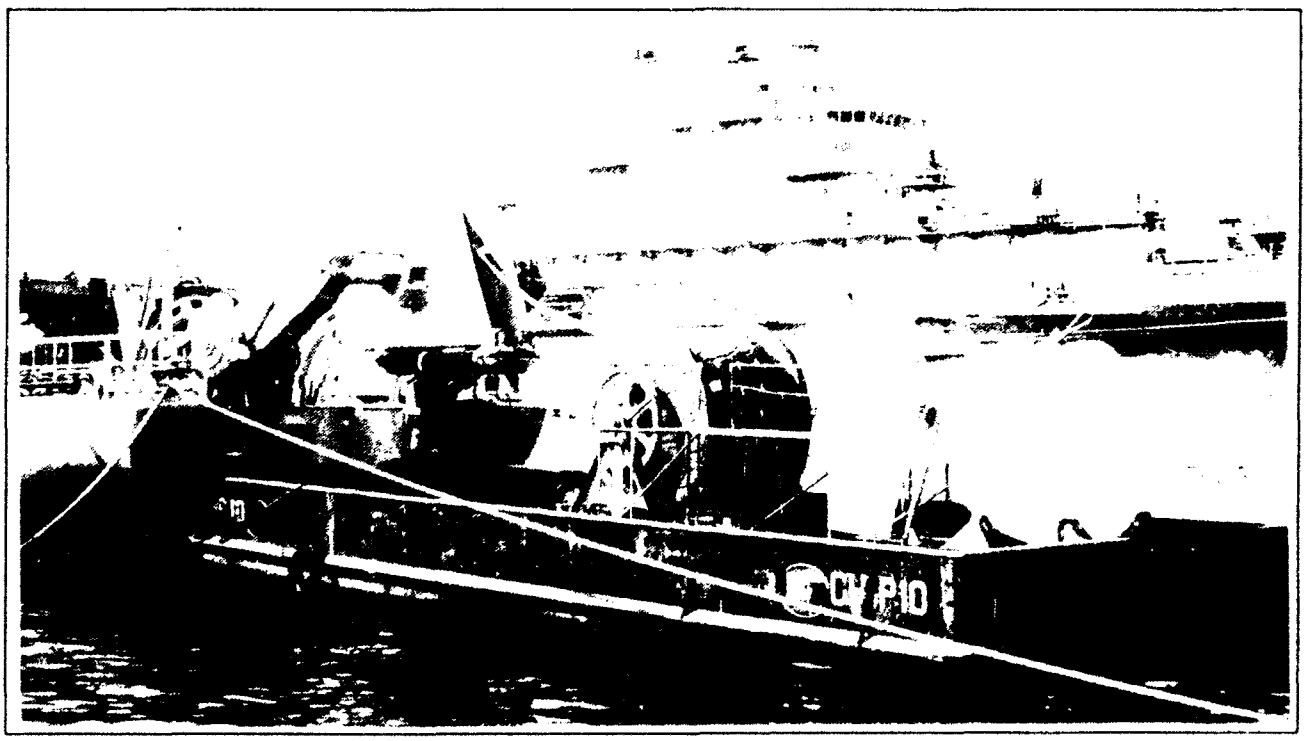
For MSN
STCAN
8, Boulevard Victor
75732 Paris Centre 15- France
Phone: (1)40-59-12-51

GESMA - BREST. The Atlantic Submarine Study Group (GESMA) of Brest is in charge of the all investigations into mine warfare especially in very low and very high frequency acoustics and magnetism.

CETEB - BREST. The Evaluation and Technical Test Center (CETEB) of Brest is in charge of the evaluation and quantification of structures and equipment intended for surface ships (equipment, hull, engines, electricity).

POINT OF CONTACT

For GESMA and CETEB
DCAN Brest
29240 Brest Naval - France
Phone: 98-22-10-80
Fax: 98-45-00-76



Embarking a Towed Sonar

DIRECTION DES CONSTRUCTIONS NAVALES (DCN) LE BASSIN D'ESSAIS DES CARENES

MISSION

Perform studies and technical testing on hydrodynamics in regard to surface vessels, submarines, weapon systems and equipment for submarines. An additional feature of this facility is to provide suggestions for improving the performance of the tested equipment.

LOCATION

Le Bassin d'Essais desCarenes is a part of the DCN located in Paris.

CAPABILITIES

Topography :

Le Bassin D'Essais Des Carenes covers an area of eight acres. The testing centre has three traction basins each equipped with a rolling platform, placed on two lateral tracks with adjustable speeds and a circular basin with rotating arm.

Facilities :

Basin No. 1 is 160 meters long, 10 meters wide, and 4 meters deep. The platform's maximum speed is 5.5 m/s.

Basin No. 2 is 155 meters long, 8 meters wide, 2 meters deep and is adjustable by the centimeter. The maximum speed of the platform is 6 m/s. This basin is also equipped with a generator of monodirectional surges adjustable up to 30 cm of depth.

Basin No. 3 is 220 meters long, 13 meters wide, 4.5 meters deep. The platform weighs 35 tons and its maximum speed is 10 m/s. It is also equipped with a generator for monodirectional surges up to 50 cm in depth.

Ventillated Screw

Circular Basin diameter is 65 meters, 5 meters deep, and the maximum speed of the rotating arm is 9 m/s on the outer edge.

Surge Container is 30 meters long, 7 meters wide, 2.4 meters in depth. It is used for testing the resistance of floating engines and vessels in the sea, with regular or irregular surges.

Flowing Water Canal is used for visual testing and maximum speed of flow of water is 6 m/s.

Hollow Tunnel with Closed Stream diameter of the stream is 0.80 meters, and maximum speed of flow of water is 18 m/s.

France

Hydrodynamics Tunnel is used to perform studies on the flow and noise levels of surface vessels and submarines.

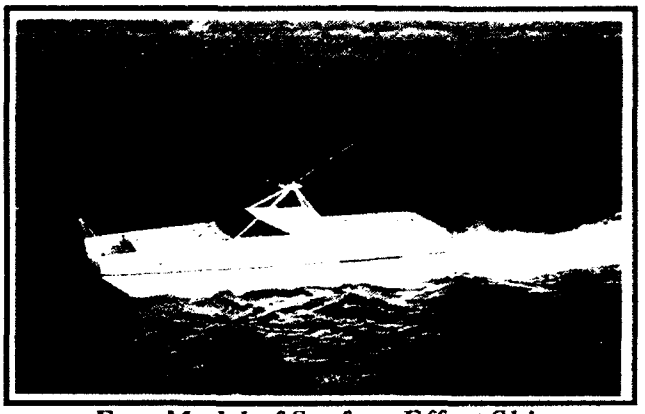
Aerodynamics Windtunnel is used to study and evaluate the flow of fumes of the vessels' exhaust systems.

Equipment and Measuring Services designing and utilizing electronics, electrical measurements and visual devices.

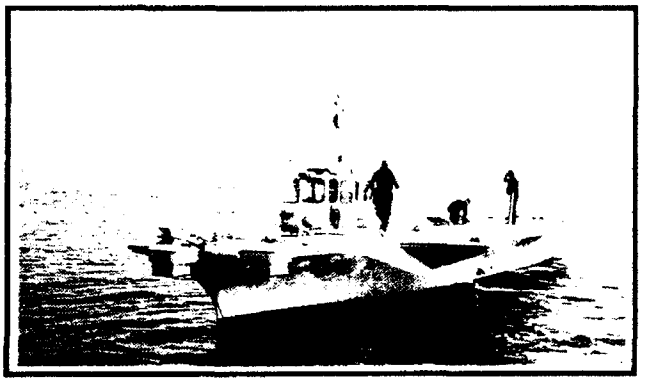
Bureau of Studies is used for planning and designing the mechanical parts of the latest instrumentation.

Work shop is used for building test models of surface vessels, submarines and propellors.

Centre for Mathematics and Calculations: assures, by the use of digital calculators, the utilization of the testing results, and to create and achieve programs that compute naval hydrodynamic calculations. Through the use of an analogical/digital simulator perform studies on the piloting of surface vessels, submarines, and nonconventional vessels.



Free Model of Surface Effect Ship



Free Model of Nuclear Aircraft Carrier

POINT OF CONTACT

Laboratoire D'Hydrodynamique Navale- Leutr de Paris
8, Boulevard Victor
75732 PARIS CEDEX 15

Telephone: (33.1) 40-59-14-00
Telex: 202184 F

Laboratoire d'Hydrodynamique Navale
Leutre du Val de Paris
Chausse' du Vesin
27100 Val de Rueil

Telephone: (33) 32-59-78-00
Fax: (33) 32-59-31-48

DIRECTION DES CONSTRUCTIONS NAVALES (DCN) MATERIAUX ET STRUCTURES NAVALS

MISSION

Perform studies and evaluation of composite materials, titanium, and different types of adhesives. Improve methods of detecting and distinguishing defects.

LOCATION

The STCAN is located in Paris and is a part of the DCN.

CAPABILITIES

Facilities :

The STCAN is a testing and research center that is equipped with the following:

A Phillips Majorie MG320 X-ray machine with constant voltage supply generated by a Phillips MG104 generator. This type of equipment is used specifically for testing non metallic materials.

SEPEMA ultrasound equipment operated by a microcomputer to detect flaws in three types of materials: composite, metallic, and ceramic.

A DUNEGAN SYSTEM 8000 acoustic emission machine equipped with eight different flaw detection systems. This equipment is used to perform studies on composite materials and on the fatigue of metallic and steel materials.

AGEMA 780 infrared thermographic camera operated by a microcomputer. This equipment is used to evaluate composite materials upon impact.

Interferometric holographic equipment with a continuous laser beam used to test the durability of composite materials.

KONTRON IBAS 2000 for the analysis of images.

POINT OF CONTACT

DCN STCAN
8, Boulevard Victor
75732 PARIS CEDEX 15

Telephone: (33-1)40-59-12-51
Telex: NAVSTEC 202184 S

France

DIRECTION DES CONSTRUCTION ET ARMES NAVALES DE TOULON (DCAN)

MISSION

The DCAN, the most important industrial complex of the Directorate of Naval Construction (DCN), is responsible for the repair of naval equipment, major maintenance of ships and aircraft, upkeep and preparation of ammunitions, studies and testing, and the central management of parts.

LOCATION

The DCAN's primary arsenal is located in Toulon and the secondary in Mourillon, both in southern France between Marseille and Nice.

CAPABILITIES

The DCAN organization consists of seven subdirectorates each of which have a specific designated function.

- Logistic Provisions,
- Personnel and Public Relations,
- Information Systems and Industrial Means,
- Naval Vessels,
- Research,
- Ammunitions, and
- Aeronautics.

Functions and Facilities :

The Subdirectorate for Logistic Provisions is responsible for or equipped with:

- locally managing the stocks necessary for the buildings in Toulon,

- a facility that covers 102,000 m² of stocking space of which 36,000 square meters are parks, and

- the management of 600,000 parts of which 450,000 are kept in stock.

The Subdirectorate of Personnel and Public Relations is responsible for:

- administration of personnel and management,

- public relations,and

- technical and vocational training.

The Subdirectorate of Information Systems and Industrial Means is responsible for:

- analyzing information and management needs,

- policy, procurement and management of industrial equipment, and

- preventing pollution caused by all of the DCAN installations.

The Subdirectorate of Naval Vessels is divided into six technical divisions:

The Repairs Division with:
- 12 graving docks of various sizes, able to accommodate all types of ships.
- a quay for repairs that is 5,000 meters long.
- four principal workshops for:
  + diesel engine repairs,
  + electrical repairs,
  + hydraulics repairs, and
  + on board living facilities.

The Armaments Division is composed of groups specializing in:
- interior and exterior transmission,
- navigation instrumentation,
- electromagnetic detection and electronic warfare,

- submarine detection and management of antisubmarine weapon systems,
- missile launches,.
- electronic measuring apparatus, and
- infantry weapons.

The Submarine Division equipped with :
- a mobile workshop able to position itself over submarines for immediate intervention, and
- a nuclear workshop that permits decontamination and intervention of radiated material.

The Mechanical Division responsible for:
- the mechanical needs of all the subdirectorates of the DCAN.
- naval vessel maintenance, and
- the production of high precision mechanical parts.

The Iron Works Division reponsible for all of the steel used in construction.

The Vessels Research Division specializes in the design and framework for all surface vessels and weapon systems.

The Subdirectorate for Research is comprised of the eight research groups described previously:
- CERTEL,
- CAPCA,
- CESDA,
- GERDSM,
- CERSTM,
- GETDL,
- CERDAN, and
- GERPY,

The Subdirectorate of Ammunitions is located at various sites for historical reasons.

The Pyrotechnics site is located on the far west side of l'Arsenal de Toulon. It occupies an area of 210 acres and is protected by an outer isolated area of 374 acres.

The Annex de Tourris, is located about ten kilometers north of Toulon. It occupies an area of 1800 acres of flat isolated terrain. It consists of ammunition warehouses, workshops, and a firing range.

The Depot Regional De Fontvieille, near Arles, is an underground storage facility for ammunition.

The warehouse in Saint-Chamas, northwest of l'Etang de Berre, is stocked with explosive cargo.

These facilities carry out the following:

- the central management of ammunition,

- the building, assembling, and servicing of weapon systems,

- the dismantling and distruction of outdated ammunition, and

- the preparation of missiles and torpedoes for firing exercises.

The Subdirectorate of Aeronautics. This facility occupies an area of 69,500 square meters and includes: a runway, hangers, and workshops for repairing aircraft and components. The Subdirectorate is divided into three operational divisions.

Aircraft Division responsible for the upkeep of four types of aircraft:
- BREGUET 1050 "ALIZE".
- ETENDARD IV and SUPER ETENDARD (assault or reconnaissance airplanes).
- CRUSADER F8E (FN) (interceptor).
- BR 1150 "ATLANTIC" and "ATLANTIC 2" used for patroling the ocean and spotting submarines

Equipment and engine division in charge of aircraft and system maintenance.

Aviation and Simulator Division performing maintenance of:
- telecommunication and navigation equipment,
- electromagnetic detection,
- underwater detection,
- weapon systems,
- electronic measuring devices, and
- testing equipment,

Technological and Composite Division. Performing studies on the conception and production of aircraft or missiles (fighter planes, air armaments, engines, Airbus 320).

POINT OF CONTACT

DCAN TOULON
BP 77 - 83800 Toulon/Naval

Telephone Services:

Standard Arsenal	94.62.90.00
Info. Services:	94.02.41.29
Public Relations:	94.02.41.94
Telex:	DCAN TOULON 430020

France

DIRECTION DES CONSTRUCTIONS DE L'AERONAUTIQUES (DCAe)

MISSION

Design, development, testing, and manufacture of military aircraft, air frames, and systems.

LOCATION

Central administration in Paris is supported by three test establishments:

Centre d'Essais en Vol (CEV) with test airfields at Bretigny, Cazauz and Istres.

Centre d' Essais des Propulseurs (CEPr) at Saclay.

Centre d' Essais Aeronautique de Toulouse (CEAT).

Design Establishments:

The Direction des Construction Aeronautiques (DCAe) is responsible for military aircraft airframe and system design, development, testing and manufacture. DCAe

- Conducts and controls weapon system programs as the coordination body for the whole program or acts as a partner with other organizations.

- Arranges technical assistance once aircraft have become operational and provides industrial spares and repair services.

- Field of activity also includes civil aircraft in conjunction with the Ministry of Transport.

- Governmental technical advisor for all aircraft and associated equipment, whether ordered by the government or not.

DCAe is thus a public sector organization which can also operate in an industrial role.

Air - to - Ground Missiles

Test Establishments:

Centre d'Essais en Vol (CEV). With test airfields at Bretigny, Cazaux and Istres, tests military aircraft and on-board equipment and sytems for conformity to specifications, and civilian aircraft for airworthiness.
In addition to flight testing fixed and rotary wing prototypes, CEV is fully equipped with flying test beds to test engines, aircraft equipment, radars, weaponry, etc. These aircraft can be made available to manufacturers in developing their equipment.

Centre d'Essais des Propulseurs (CEPr). Based at Saclay, tests all types of aircraft propulsion units and related subassemblies, equipment, accessories and consumables

Centre d'Essais Aeronautique de Toulousse (CEAT). Ground testing (aerodynamics, materials and structural) of airframes, aircraft systems and equipment for all types of aircraft.

CENTRE D'ESSAIS EN VOL (CEV)

MISSION

Conduct all official flight testing of aircraft, airborne systems and weapons for the Ministry of Defense and Ministry of Transport. With the Centre d'Essais Aeronautique at Toulouse and the Centre d'Essais des Propulseurs at Saclay, CEV forms a group of complimentary des Propulseurs facilities controlled by the Direction Technique D' Construction Aeronautiques.

LOCATION

The flignt test center consists of a main station at Bretigny and test stations at Istres and Cazaux and an annex at Melun-Villaroche airport southeast of Paris.

CAPABILITIES

Main station at Bretigny-sur-Orge (Essonne):

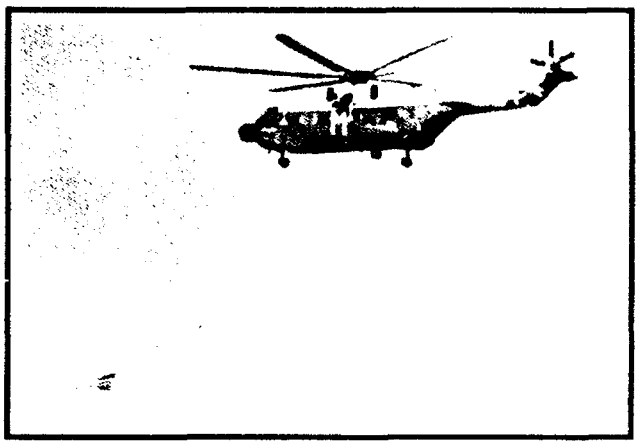
- Management.
- Telecommunications, equipment and rotary wing
- aircraft test branches.
- aerospace Medic Laboratory.
- Flight test and acceptance air traffic main center.
- 1400 personnel.

The Flight Test Center, primary user of the airfield, assumes responsibilty for all aviation activity in the Bretigny area.

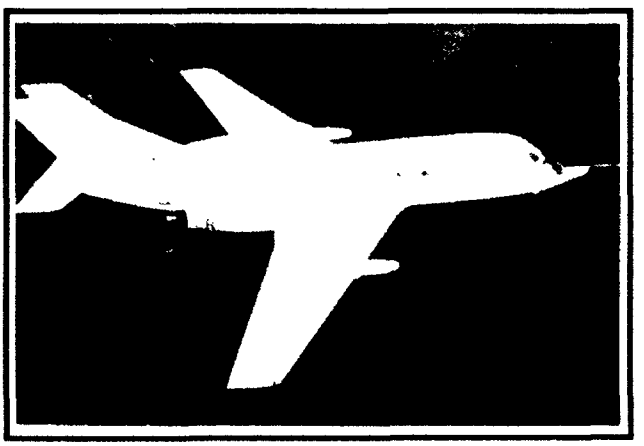
Because of environmental constraints, the proximity of Orly, and population density in the region, all prototype aircraft test activities have been transferred to the test station at Istres. The length of the runway constructed on the virtually deserted Crau plain, together with the climate, make Istres an exceptionally suitable test area. The Breguet-Dassault and SNECMA flight test departments are also located at Istres, which greatly facilitates official test flying and evaluation of prototypes.

The operation of the base is under the general control of the French Air Force, the main user.

Cazaux Test Station (S.W. - France):



Super Hornet Test



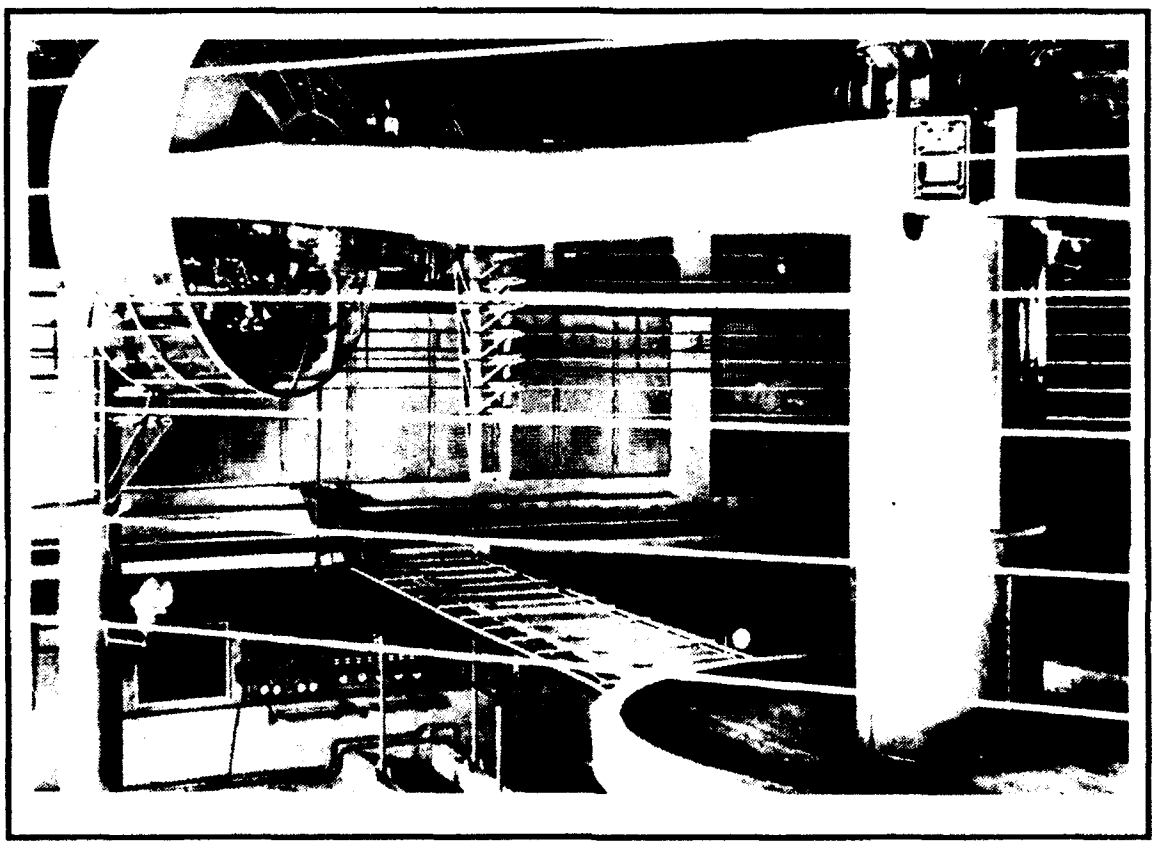
MYSTERE 20 Test Bed

- Development tests of air armaments.
- Adaptation trials of weapons to service aircraft and helicopter types or on prototypes.
- Personnel strength: 420.

The availability of air space over the sea and the Atlantic firing range over the sea, under the control of the CEL, together with the ground range of CALAMAR, under CEV control, make Cazaux a prime location in Europe for testing of airborne weapons.

The CEV aircraft fleet furnishes support and target aircraft for the operation of the Atlantic firing range (CEL).

Operation of the base is under the overall control of the French Air Force, main user of Cazaux airfield.



Centrifugal Machine

LA VILLE DE L'ESPACE-TOULOUSE (CST)

MISSION

CNES, the French national space agency, is responsible for the implementation of French space policy.

The Toulouse Space Center, or CST, is the organization's main technology and engineering center. It houses the resources and facilities that enable France to undertake and control space programs, from design through orbital exploitation. Note, however, that launch vehicle development activities and launch operations are undertaken at Evry (a Paris suburb) and at French Guiana, respectively.

LOCATION

On the Ranqueil science complex southeast of Toulouse in the Mid-Pyrenees.

CAPABILITIES

Organization : The CNES Toulouse Space Center is organized to perform six main roles:

Mission analysis and preparation of future programs (medium and long term).

Support for the development of space technologies and provision of expert advice.

Control of programs during the development phase.

Exploitation of systems during the operational phase.

Management and use of high-cost facilities.

Training and dissemination of knowledge.

The duties associated with these roles are the responsibility of a number of specialized sub-directorates together making up one of the Center's Directorates. Particular importance has been given to the new Hermes spaceplane program which is run from Toulouse; a "Hermes and Manned Flights" Directorate was set up at the CST in 1986.

Ariane 4 Fairing Undergoing Tests at Toulouse

Ranges :

The CST extends over some 50 hectares. For ten years now, space activities having increased considerably, over 2,000 people have been permanently employed on the site, either directly by CNES or by the groups or affiliates set up to commercialize services and products connected with new space applications.

Facilities :

The CST has the necessary know-how in the following fields: optics, electronics, onboard data handling, detection, robotics, communications and data transmission, energy, thermophysics, mechanics, image processing, etc. With the advent of Hermes and manned flight, new disciplines must now be added to the list: rendezvous and docking techniques, orbital navigation and attitude control, life support and environmental control.

Together, these skills represent a fund of resources whose level is constantly maintained and improved so that CNES

can continue in its role of expert in its relations with industry and laboratories.

The CST operates the full range of major facilities, including those for the operational exploitation of space systems, required for system operation from launch and throughout each system's useful lifetime (typically 5 to 10 years). As might be expected, these facilities make extensive use of computers. In fact, the array of computers and associated equipment for processing satellite data is unique in certain respects and one of the most powerful in France.

The design concept underlying this vital tool for the exploitation of spacecraft and space systems was guided by two overriding requirements: first the need to organize all functions hierarchically (so, for instance, that routine scientific computations do not interfere with real-time data acquisition at high bit rates), and, secondly, the selection of a homogeneous range of equipment to ensure the necessary redundancy and backup.

The CST satellite operations center tracks and controls spacecraft from the end of the launch phase on. The center is fully equipped with high-speed data transmission systems providing links with the tracking and command stations located at Pretoria, Kourou, and Aussaguel, near Toulouse. These stations, known as telemetry, tracking, and command, or TT&C stations, are used to control spacecraft by performing telemetry reception, command transmission and tracking.

The need to correct image data returned by the Spot satellite led CNES to develop a range of special-purpose, computer-based systems at the CST that is without parallel in Europe.

To these major facilities for spacecraft exploitation, also add the special-purpose balloon release center at Aire-sur-l'Adour.

In 1985, France proposed that Europe undertake the construction of a new space vehicle, namely the Hermes spaceplane. This vehicle, to be placed in orbit by the Ariane 5 launcher, will be suitable for three main types of missions: orbital intervention, transportation of cargo and crews between an orbital space station and Earth, and autonomous scientific missions. The Hermes project represents one of the prime technological challenges for France and Europe over the next 10 years. As such, this remarkable project will infuse immense drive. Aside from the spaceplane proper, the project calls for the development of a wide range of associated installations including a test center and preparation, refurbishment, and checkout facilities.

At CNES, a Hermes and Manned Flights Directorate has been created at Toulouse. It will be responsible for the Hermes definition studies, prime contractorship during the development of the spaceplane and associated ground systems, crew training and the development or demonstration flights.

TYPICAL PROJECTS SUPPORTED

- Telecom 1, a satellite communications system comprising three spacecraft (Telecom 1A, 1B and 1C), undertaken entirely as a national project for the DGT of the French PTT Administration and for the French Ministry of Defense.

- TDF 1, a direct broadcasting satellite system operated by Tele Diffusion de France (TDF), and produced in cooperation with the Federal Republic of Germany.

- Spot, an Earth observation system developed as a national project and comprising one satellite plus an array of ground facilities to enable the Spot Image Company, located at Toulouse alongside the CST, to distribute Spot images worldwide.

Added to these major programs, are a number of projects with more limited objectives, including Argos, SarsatCospas, manned flights, and experiments undertaken within a framework of bilateral cooperation.

POINT OF CONTACT

Centre National D'etudes Spatiales (CNES)
Address: Centre Spatial de Toulouse (CST)
18, avenue Edouard-Belin
31055 TOULOUSE CEDEX
Tel: 61.27.31.31 - Telex CNES T 531 081 F
Address of head office: CNES-Siege Social
2, place Maurice-Quentin
75039 PARIS CEDEX 01 - France

Telecom 1 Satellite Undergoing Tests

DIRECTION DES ENGINS (DEN)

MISSION

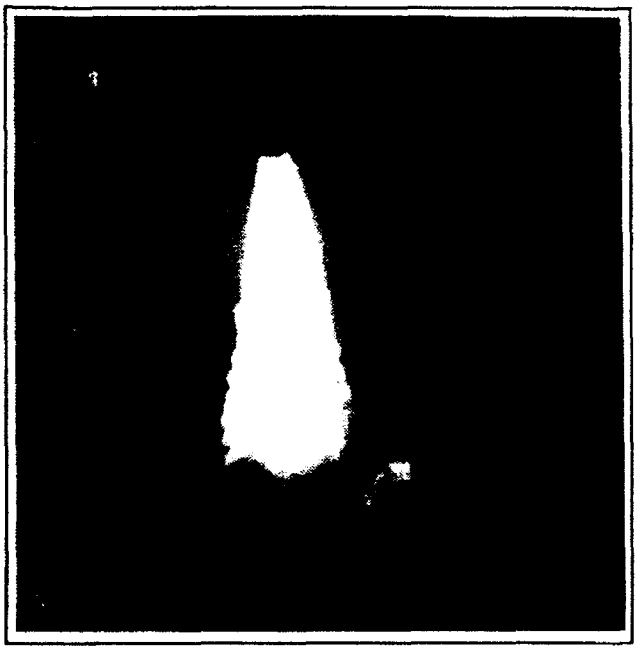
Develop:

Conventional tactical missiles and missile-based weapon systems.
Strategic and prestrategic nuclear missiles and missile-based weapon systems.
Propellants and explosives.
Space systems.

In addition to a central office for the day-to-day executive, administrative and management tasks, these varied activities require three technical divisions, responsible for ballistic missiles, tactical missiles, and low and high explosives.

There are also four establishments in the French provinces, namely:

- Centre d'Essais des Landes at Biscarrosse (CEL) (near
- Arcachon);
- Centre d'Essais de la Mediterranee (CEM) at Toulon;
- Centre d'Achevement et d'Essais des Propulseurs et
- Engins (CAEPE) at Sain Medard en Jalles (near
- Bordeaux); and
- The Laboratoire de Recherches Balistiques et Aerodynamiques (LRBA) at Vernon (Normandy).



Ballistic Missile Launch

Air-to-Ground Missile Launch

Technical Divisions :

The three technical divisions of DEN provide information necessary for making program decisions and, because they have no production facilities of their own, award contracts to private or public industry to perform the work for program completion.

• Service Technique des Engins Balistiques (STEN). This Division specializes in strategic and prestrategic nuclear missiles (or weapon systems) and space systems. It is responsible for a small number of important programs contributing to France's deterrent policy. The French nuclear forces are equipped with these missile systems.

• Service Technique des Engins Tactiques (STET). Concentrates on tactical missiles. It is responsible for a large number of non-nuclear programs involving all missile categories with the exception of the antitank type. It must work closely with the other DGA Directorates because all or parts of its weapon systems are fitted to carriers manufactured under their responsibility.

• Service Technique des Poudres et Explosifs (STPE). As its name implies, this Division is responsible for propellants and explosives. It is also the official controlling authority for their production, sale and import.

POINT OF CONTACT :

Direction des Engins (DEN)
26, Boulevard Victor, 75996 PARIS ARMEES, FRANCE
Tel. (1) 45.52.43.21

France

CENTRE D'ESSAIS DES LANDES (CEL)

MISSION

The Centre d'Essais des Landes range is part of the Missile Directorate (Direction des Engins). It mission is to:

Design the test set ups of every new weapon system experimc ıt in the Atlantic zone.

Assume command and control of all tests and firings, thereby coordinating the action of all participants, whether placed under its direct control or placed at its disposal by other organizations.

Take every step required by the safeguarding of lives and properties present within the land, sea and air environment involved by the firings.

Deliver the results of the tests in a form best suited to the needs of the technical and operational organisms.

The range is open to the Technical Directorates of the Delegation Generale pour L'Armement and the Navy, Army and Airforce Military staffs. Activities include instruction and testing for evaluation and training and for scientific or technical organizations. Tests may require special measurement and observation facilities, or large safety areas. Within the framework of some special cooperation agreements the range is also open to some foreign organizations.

LOCATION

West coast of France south of Biscarrosse.

CAPABILITIES

Topography : The principal establishment covers a land area of 93 square miles on the west coast of France. Its northern boundary is the Biscarrossee city to Biscarrosse beach road; the eastern one is the pool line and the southern one a perpendicular two miles north of Mimizan beach. There are four outstations and the Test and Tracking Naval Group (ALGROUPEN).

Sub Launched Ballistic Missile

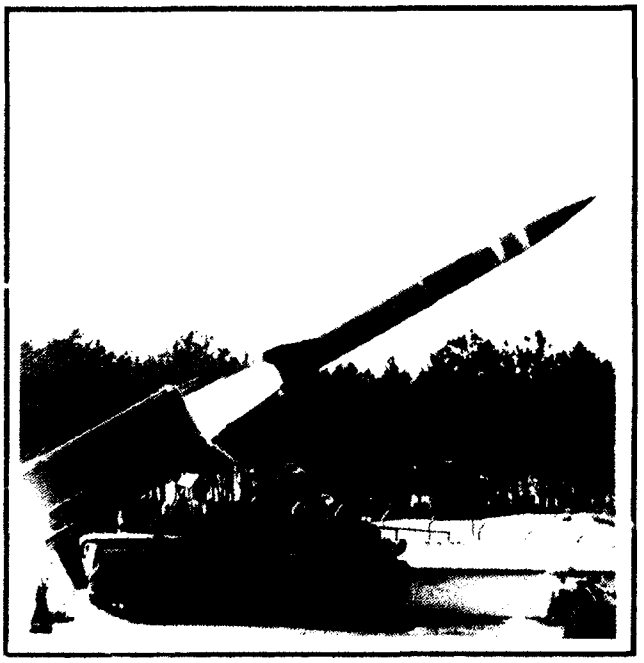
Ranges:

- Bretagne (Britanny), Hourtin. Cape Arcachon;
- L'Especier, Bayonne;
- The land range of Captieux with an area of 62 square miles; and
- In the Azores Islands, the Flores tracking station and the air base of Santa Maria.

Launch Bases and Recovery Zones

- pilotless targets base
- ground-to-air test base } Naouas
- ground-to-ground launch base
- ballistic base } North Leouges
- artillery training base Along the Leouges shore
- scientific base
- space base } Sainte Eulalie
- ballistics recovery zone Atlantic Ocean
- air-to-surface recovery zone South Leouges
- short range ground to ground base
- air-to-surface missiles } Captieux and bombs safety zone

The Franco-Portuguese agreement of 7 April 1964 provides for the creation of two annexes of the Centre d'Essais des Landes in the Azores archipelago: one located on the Santa Maria air base, in the easternmost of the nine islands, the other in the westernmost island of Flores.



Ground Launched Ballistic Missile

Santa Maria supports aircraft temporarily stationed in the mid-Atlantic to participate in the firings. It also is a stopover for the fights between France and the Flores Annex of the Centre d'Essais des Landes.

Santa Maria is the location of the Air Traffic Control Centre of the Azores area which is responsible for airspace reservations required by the firings.

• Flores Annex gathers data on the reentry phase of ballistic missiles. Its geographical position also qualifies it as a down-range station for the Kourou Range belonging to the Centre National d'Etudes Spatiales.

• Main installations of Flores are a BEARN trajectory radar and its associated computer, a high precision synchronization unit, a telecommunications station and aircraft guidance equipment. Whenever the missile splash zones are not too far from Flores, the results gathered by this station, together with the data collected by mobile units, provide the desired accuracy in an area where measurements are usually difficult.

• The Hourtin Annex has been installed sixty miles north of Biscarrosse, in order to make available to the Centre d'Essais des Landes a flanking station, i.e., a station located in a lateral position with respect to long range and high altitude missile trajectories.

This location has the advantage over Biscarrosse of receiving undamped missile signals under all conditions.

Hourtin is equipped with:

- a radar station consisting of an AQUITAINE and a BEARN radar, as well as their signal handling computer;
- a telemetry receiving station;
- an interferometry station operating in close liaison with similar installations in the Biscarrosse area;
- a high performance trajectography device called L-Structure, providing with great accuracy ballistic injection velocities of long range missiles; and
- living quarters, mess halls and sport facilities.

• In its Captieux Annex, the Centre d'Essais des Landes carries out firings, bombings and various other tests requiring large safety areas on the ground. Main installations include:

- a range used for the development of short range surface-to-surface missiles and for the initial phases of surface-to-air and air-to-air missile firings;
- another range used for Air Force air-to-surface training; and
- a safety zone used by various government organizations dealing with explosives.

Facilities/Resources

Instrumentation:

Optics:

- nine optical sites with thirteen permanent kinetheodolites and five kinetelescopes;

- four mobile kinetheodolites;
- five infrared trackers and radiometers;
- one mobile infrared tracker Minilir;
- one mobile radiometry facility Casimir;
- high speed cameras located in the vicinty of the launch bases;
- a film processing plant; and
- a printing service.

Radio Electric Facilities:

- Telemetry:
  + there are four permanent telemetry stations located in Sainte-Eulalie (with the antennas Cyclope and Antares), on the optical site number three (with the antennas Sparte and Telemaque), in the Hourin flanking station (Antennas Sparte, Telemaque and Antares) and in Bretagne (Britanny);
  + there is also a telemetry station on board the testing and tracking ship HENRI POINCARE (four Antares antennas and one telemaque).

- Remote Controlled Destruction:
  + three stations (Biscarrosse, Hourtin, Bretagne).

- Radars:
  + thirteen instrumentation radars Aquitaine, Bearn, and Gascogne (Biscarrosse, Hourtin, Quimper, Flores and Henri Poincare);
  + one multiple object tracking radar (Artois);
  + two mobile radars LP; and
  + two air and sea surveillance radars.

Computers:

- two parallel CII 10070 computers used for real time and post test data processing, one MITRA 15 running the data displays, and one MITRA 15 running the plotting tables;
- one CII 10020 digital computer for the processing of telemetry data;
- three MITRA 115 located on the Biscarrosse, Hourtin and Bretagne radar sites;
- one MITRA 115 running special data displays;
- one MITRA 15 associated to each tracking radar Artois, Aquitaine or Bearn;
- one MITRA 15 devoted to the processing of aerology data;
- two MITRA 525 and two MITRA 15 on board the HENRI POINCARE; and
- one computer used for the control of stocks and accounting.

Telecommunications:

- one tropospheric link Biscarrosse - Hourtin - Quimper;
- intercom networks;
- data links;
- a multiplex color television network;
- HF, VHF, UHF networks; and
- intrusion detectors, fire alarms and an alarm control center.

Meteorology:

- ground level observations and measurements (Biscarrosse, Captieux, Flores);
- weather forecasts;
- aerial measurements (Biscarrosse, Captieux, and Bretagne on request); and
- reception of geostationary and non geostationary satellite pictures in the visible and infrared spectrum.

Three DC-7C aircraft equipped with:

- an upper radome containing telemetry antennae;
- a lower radome containing a radar antenna; and
- four look-out blisters.

The navigation system of the aircraft is capable of missile-localization - and therefore the splash point - within fifty yards.

Detached with their crews by the Bretigny Air Test Center, the Range Observation and Measurement Aircraft (French abbreviation: A.M.O.R.) are at the disposal of the Centre d'Essais des Landes to operate in the vicinity of the splash zone in liaison with the Flores station: their mission is to receive telemetry signals from the missile and to localize accurately the splash point.

Naval Units: belong to the Test and Tracking Naval Group (ALGROUPEM) and help expand the activities of CEL from the vicinity of the European coast to the splash zones of the missiles. These units are in charge of:

- safety and security in the Centre d'Essais des Landes waters and around each splash zone;
- data collection and trajectography of the missile;
- accurate localization of the splash point; and
- meteorological surveys including high altitude measurements.

ALGROUPEM Consist of:

- the Testing and Tracking Ship HENRI POINCARE, which carries devices such as radars, tracking installations, computers, timing units, telemetry and communications;
- three Frigates, BASQUE, BRETON and SAVOYARD, carrying telemetry installations; and
- three Minesweepers, ALGOL, BELLATRIX, VEGA

and the salvage vessel LUCIOLE, forming together the 24th Naval Division, in charge of safety and security in the Centre d'Essais des Landes waters.

To this permanent naval force are added, for specific operations, other naval and naval air units, such as the aircraft belonging to the Naval Air Station Lan-Bihoue.

The Service in charge of Scientific Data Handling (French abbreviation: STIS). Carries out all calculations concerning the activities of the Centre d'Essais des Landes, both in real time during the firings and in deferred time during their later analysis.

STIS's real time duties involve:

- distribution of signals leading to synchronous sampling of data from the various measuring equipments;
- handling of those data in order to localize the missile and discharge the Range's safeguarding duties, by comuting and plotting instantaneous positions and impact at each comuting cycle: and
- automatic guidance of aircraft and missiles and plotting of their positions to satisfy planned interceptions.

STIS's deferred time duties involve:

- delivery of results requested by whichever organization uses the facilities of the range:
  these can be either measurements involving the entire firing sequence (position, velocity, possibly acceleration or attitude), instantaneous trajectory data such as miss distances or impact positions, or telemetered data concerning the missile's internal behaviour; and
- evaluation of the performances of the range's own equipment.

Main computers available at STIS are two CII 10070, two CII 10020, one T.2000 and one SDS 920.

Simulation Facilities:

- a facility allowing the simulation of velocities up to 1,500m/sec and accelerations up to 1,000/sec square. This facility includes:

  + the single rail, 1,200 meters long R1 track, which is due to be extended to 4,000 meters;
  + the dual rail, 400 meters long R2 track, used essentially for amunition testing; and
  + the associated equipments and networks, aimed mainly at the control of the tests, and internal and external observations and measurements.

- a facility designed to simulate very strong electromagnetic pulses in a 75,000 cubic meters volume unique in Europe by its capacity and its level, this facility is an essential tool in the study of the hardening of tactical and ballistic weapons.

Targets:

- operation and maintenance of the CT 20 (remote controlled turbojet target);
- operation and maintenance of sea targets;
- design and manufacture of aerial tows; and
- design of sea targets.

France

MEDITERRANEAN TEST CENTER (CEM)

MISSION

Make available for the Armed Forces (general staff and technical services) and any national organization any general and permanent facilities for achievement of military, technical and scientific activities which require extensive guarded and controlled zones.

The Mediterranean Test Center is a general test center under the supervision of the French General Armaments (DGA) Delegate and Rocketry Techniques Agency (DTEN).

LOCATION

The CEM management and the technical and logistic support services are grouped in the Mourillon Technical Establishment at the Toulon Dock Yard. The main testing and firing base is on the Ile du Levant.

CAPABILITIES

Topography :

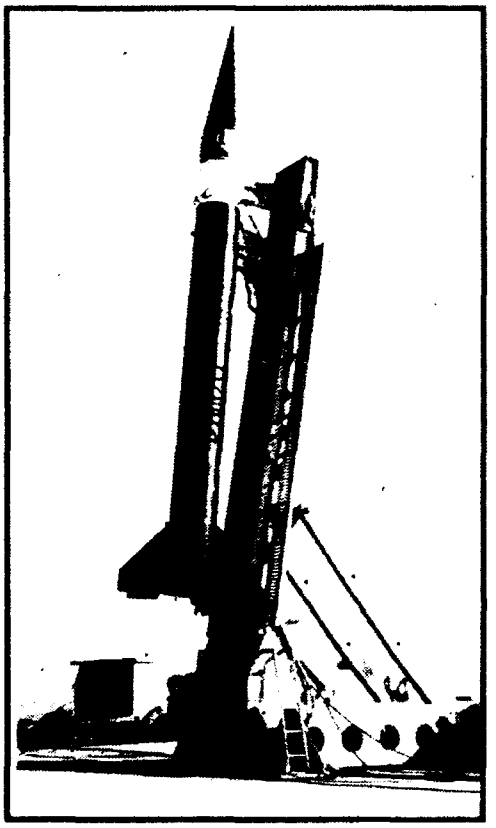
The great depth of the sea bed at such short range from the coastline, general sea and sky conditions and the proximity to the large naval dockyard at Toulon and the military air bases at Istres, Hyeres, Saint-Raphael and Orange make this a unique location in France for experimental and training launches covering both underwater and above water weapon systems. For this reason the CEM is of particular interest to the Navy.

Ranges :

Main Base at Levant (BPL). Most of the CEM's experiment equipment is grouped together at this base, where the main part of the tests are carried out.

Measurement and test control equipment. Trajectory calculations and observations are ensured by:

- A 6 station optical observation base spread over about 40 kilometers, equipped with cinetheodolites and high speed cameras with very long focal lengths. This base is one of the most attractive features of the center because of the excellent visibility throughout most of the year.



Launch of a M. M. 38 Sea/Sea Missile

Track radars grouped into four stations, three of which are at the BPL and one on the continent. The location and altitude of the radars were selected to cover all the needs of the center. The most precise radars are the BEARN type, with an angular error of less than one minute and a range precision within a few meters. The COTAL radars are older and less precise. They complement the tracking system and provide a target designation function for the BEARN. They are also used to locate moving echoes for which high precision is not required.

An underwater trajectory polygon, called TREMAIL, consisting of a network of hydrophones placed under 2,000 to 2,500 meters of water. This installation is unique in France, and even in Europe. It can localize up to five

underwater vehicles fitted with acoustic transmitters, with precision and in real time, and can therefore be used for guidance.

Three stations equipped with high gain automatic track antennas and modern recording equipment receive telemetric transmissions from missiles in flight. The main Maupertuis station is equipped for preflight test and real time monitoring of certain parameters. For this purpose it also has numerous demodulators, switching systems and display devices.

The COSMAR Polygon. The purpose of the COSMAR is to carry out a fast, economic and sufficiently precise operational check of the heading, azimuth and range data supplied by the main sensing system associated with weapon systems installed on surface ships, submarines and ASW helicopters. The tests conducted at this polygon compare sensor data to reference data supplied by special Minilirs trajectory calculation equipment. Projectiles are fitted with an IR source and are automatically tracked to give very precise angular measurements.

A COSMAR test sequence takes two days: one at the Toulon dockyard wharf where the required equipment is installed aboard and aligned with the axis of the ship, and a second day which is spent to the north of the Ile Du Levant, maneuvering the ship through a certain number of carefully placed courses to take best advantage of the responder sonars or radars in the zone and the trajectory calculation equipment.

The COSMAR zone and the equipment which is used there are completely independent from the rest of the firing range. A preliminary report of test results is furnished to the ship several days after testing, and the complete, definitive report follows within a few weeks.

The Renardiere Polygon. The Renardiere polygon is on the SaintMandrier peninsula, easily accessible and near Toulon. The land area (approximately 10 hectares) and relief are favorable to many types of tests.

The cliffs at the ocean's edge make the site particularly useful for light weapons which are fired at negative elevation, such as is the case for helicopter weapons.

Up until 1963, the polygon was the main component of the Toulon technical establishment for the former DEFA, which has now become the ground weapons techniques agency (DTAT). The polygon is still used mainly by this agency, essentially for:

- munitions admission and receiving trials,
- test shots,
- equipment development and debugging (20 mm and 30 mm guns), and
- firing from helicopters.

The Renardiere polygon can also be used for:

- small caliber weapon schools; and
- helicopter training (Navy and Army).

To fulfill its testing and safeguarding missions, the polygon has an operations command post which centralizes all information and ensures links with the coordination centers of the maritime district. It is also equipped with surveillance radar and optical stations.

For experiments, the command post also controls:

- one COTAL trajectory radar with plotting table outputs,
- observation cameras, and
- theodolites.

Facilities :

• Mourillon Technical Establishment. In addition to the command and services, this includes:

- departments responsible for utilization of the tests,
- special services required for technical support of the test and measurement installations,
- optics shop,
- electronics and mechanics shop, and
- logistic support and administration services of the center.

Information gathered by measuring devices during testing are processed to provide the user with the requested results.

Except for certain tests where the results acquired in real time are sufficient, or can be processed on site immediately after testing, most of the test results are processed off-line, using the following services:

- film lab: because of the importance of optical measuring devices, the CEM has acquired a very complete and modern photographic and filming laboratory which can process a wide variety of emulsions. Time is shared with other military organizations in the Toulon region.

- data analysis service: this service analyzes the data recorded during a test, and selects the best information in close cooperation with the user to determine how the data will be processed and assembled for the computer center. The final results are returned to the client in the desired form: listing, plan drawing, magnetic tape, etc.

- computer center: this essentially includes an IBM 360-44 computer and a very complete analog data acquisition and ADC installation. The great variety of computer processes and programs which are required for test analysis demands a relatively large computer network which would be wasted if it were used only for CEM test activities. This is why the same equipment is used by other defense organizations in the Toulon region.

- a general electronics and mechanics shop is also available for adapting new equipment to existing systems.

Transport ships: Sea transport between Port-Pothuau and Port-Avis on the Ile du Levant is ensured:

- by an LCT for vehicles (trucks, tanks, cannons, etc.); the LCT makes an average of three round trips per week, and

- by two ships, Ariel and Sylphe, each with a capacity of about 400 persons; the ships alternate, making daily crossings between the island and the continent from Monday to Friday.

Auxiliary Air and Sea Equipment: for surveillance and policing of the firing range, and for auxiliary links between the Ile du Levant and Port Cros or with ships which cannot enter Port-Avis, the BPL also has:

- one Alouette-type helicopter operated by the Third Maritime District Navy Air,

- one Tourmaline fast launch - 27 meters in length, with a speed of 22 knots,

- three small launches, two of which can be remotely controlled, whose priority mission is to tow the marine targets, and

- one long boat.

Conduct of Tests. The test center coordinates its own equipment, the "customer's" equipment and that of assisting organizations. For this purpose, several command posts have been set up, mainly in the Madone operations building which occupies a central position on the island.

- The operations post ensures the permanent link with external organizations and makes medium term decisions.

- The command post makes all short term decisions allowing the conduct of tests. During preparation for a shot, the command post gathers all information concerning preparation of test data and participants, and conducts the countdown.

- The safeguard post is responsible for the decision to destroy a missile in flight or to recover a target.

- The measurement post brings together all the data from measurement and computer facilities on the firing range.

These various posts feature modern equipment which continually display basic data and allow dialogue with the missile computer to obtain specific information.

Resources

For data processing during the tests, a group of computers gathers the data from the various measurement sensors (radars, cinetheodolites, telemetric antennas, etc.) in real time, prepares them to designate their objectives to the sensors, displays them immediately in a form which can be used for conducting the test, and finally records the data for closer examination later.

Each element of this measuring apparatus is synchronized with the other elements by means of a very precise mother clock system and very complete time distribution network.

Targets :

The firing range can implement air and sea practice targets.

The airborne targets are:

either targets towed by piloted or remotely controlled planes, for artillery shots, or

rocket RPVs (CT 20) equipped with echo boosters to aid target detection by the missile or artillery systems under trial.

The marine targets, in addition to the use of hulls of decommissioned ships, are trimaran type metal structures with radar echo boosters to simulate warships. They are towed by remotely controlled launchers.

TYPICAL PROJECTS

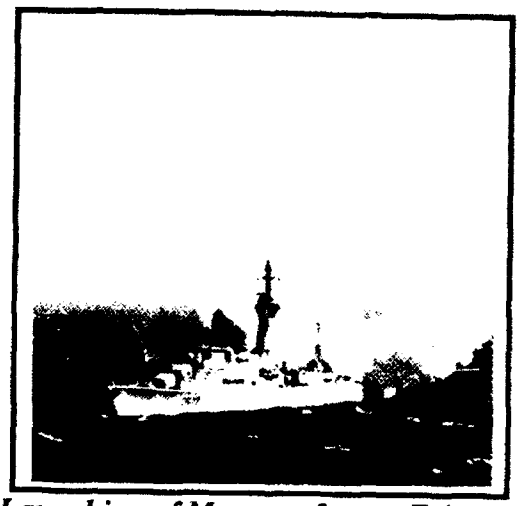
Experimental launches of tactical rockets: MM 38, AM 39, MASURCA, CROTALE, MM 40,

- underwater experiments: torpedoes,

- experiments not involving launches, for weapon system development: tracking of marine or airborne targets by homing guidance devices, sonar regulation,

- receiving, evaluating or training launches for the various Armed Forces (with or without measurements): ground/air, air/ground, air/air, sea/air, air/sea, sea/sea, and

- systematic and overall checkout of the operational condition of Navy ships, on the COSMAR polygon.

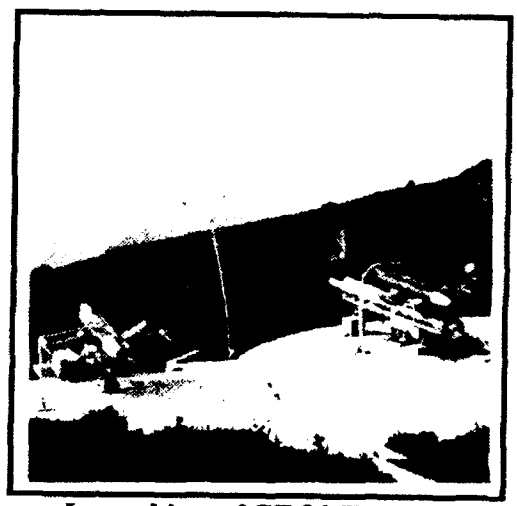


Launching of Masurca from a Frigate

POINT OF CONTACT

Monsieur le Capitaine de Vaisseau
Director du Centre d'Essais
de la Mediterranee
8380 Toulon Naval
Telephone:
Management and Service - Dockyard Switchboard (94) 249100

Mission Control Center



Launching of CT 20 Targets

France

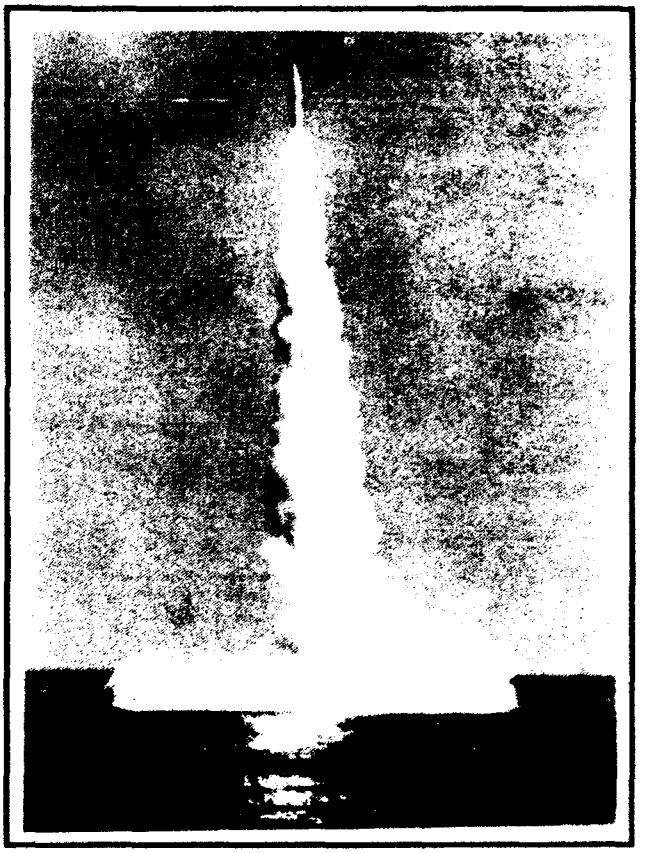
CENTRE D' ACHEVEMENT ET D'ESSAIS DES PROPULSEURS ET ENGINS (CAEPE)

MISSION

Conduct tests on propellants and propulsion units.

Capabilities :

Its findings are used by the technical divisions of the Directorate or other organizations and industrial firms. It also provides the facilities necessary for design and construction companies to complete production of large propulsion units, assemble ballistic missiles and perform tests.



SLBM Launch

LABORATOIRE DE RECHERCHES BALISTIQUES ET AERODYNAMIQUES (LRBA)

MISSION

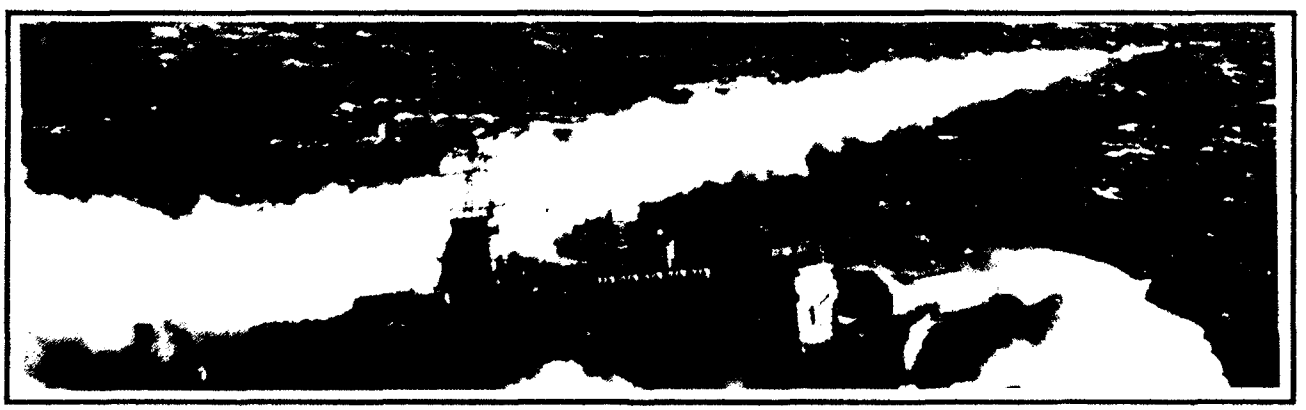
This laboratory specializes in missile inertial guidance, aerodynamics and equipment, and environmental tests.

Capabilities :

Assesses gyroscope and accelerometer inertial guidance components and systems for all the Directorates of DGA. Conducts tests for the technical divisions of the DGA Directorates and industrial firms and organizations outside DGA, and participates in the work of the DGA technical divisions.

Test facilities in aerodynamics, inertial guidance and environment are extremely sophisticated. The combination of these facilities with its expertise has made the LRBA the official Ministry of Defence laboratory for absolute calibration of vibration sensors, the leading DGA laboratory for static and dynamic angular metrology, and the leading French laboratory for electrical metrology.

Missile Guidance Tests



DIRECTION DE ELECTRONIQUE ET DE L'INFORMATIQUE (DEI)

MISSION

Coordinate industrial policy for electronics and micro processors.

Conduct research and inter-Service studies and programs on infrastructure transmission systems and computerized command and control systems.

ORGANIZATION AND FACILITIES

To fulfill its mission, the DEI comprises:

Central Administration. The Central Administration undertakes most of the DEI's functional mission such as:

- taking part in the elaboration of specific electronic and data processing research, design or development programs;

- avoiding duplication and narrowing the gap between design and development programs;

- standardization;

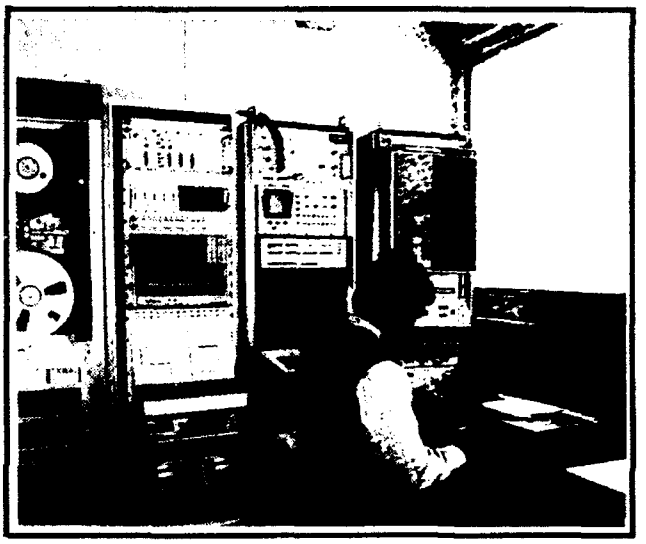
- promoting test means, methods, components, and techniques;

- taking advantage of its thorough knowledge of the electronic and data processing industrial sector to prepare possible industrial policy guide lines, in liaison with the SCAI;

- centralizing, for the DGA, some procedures specific to the general data processing activity;

- motivating the activity of international cooperation groups, in the electronic domain;

- contributing to various export actions (financial aid from the State, monitoring expansion in the French armament electronics industry).



Data Processing Center

In addition, it fulfills an operational mission: the implementation of means and procedures ensuring the security of the information within the DGA and the industries involved in armament production.

Technical Division. The Service Technique de l'Electronique et de l'Information (STEI), located in the Fort of Issy-les-Moulineaux, is divided into an administrative department and three "programs" departments:

- Nuclear and Gendarmerie networks;

- Infrastructure networks; and

- Command and teleprocessing systems; and into two "products and techniques" departments:

- Systems, equipment and products; and

- Electronic component technologies.

The STEI assumes most of the DEI's operational function, i.e. it takes charge of programs concerning:

- inter-arms of Chief of Armed Forces Staff transmission systems (HERMES, TELEMAC, SYRACUS I and II, etc.);

- conventional, non tactical networks used by the three Services and the Gendarmerie; and

- inter-arms of CEMA nuclear command systems.

The STEI is also responsible for the development of products such as:

- transmission and command systems intended:
  + to initiate the use of nuclear weapons,
  + to meet requirements expressed by the government and the Staff of the Armed Forces,
  + to meet some of the requirements expressed by a particular Staff, when the corresponding network or system is not too closely integrated in weapon control;

- actions of command interest in the electronic and data processing domain:
  + either at overall design level with a view to prepare the future, continuing the design and research work carried out by the DRET,
  + or at products level, when such products are intended to be used in several weapon systems developed by the DGA.

The Centre d'Electronique de l'Armement (CELAR) is located at Bruz, near Rennes. The CELAR, whose initial task is to test and evaluate the electronic equipment intended for the Armed Forces, has developed, in particular, some simulation techniques which are either wholly digital, or built round the equipment to be evaluated. Subsequently the CELAR was then entrusted with other missions in the domain of:

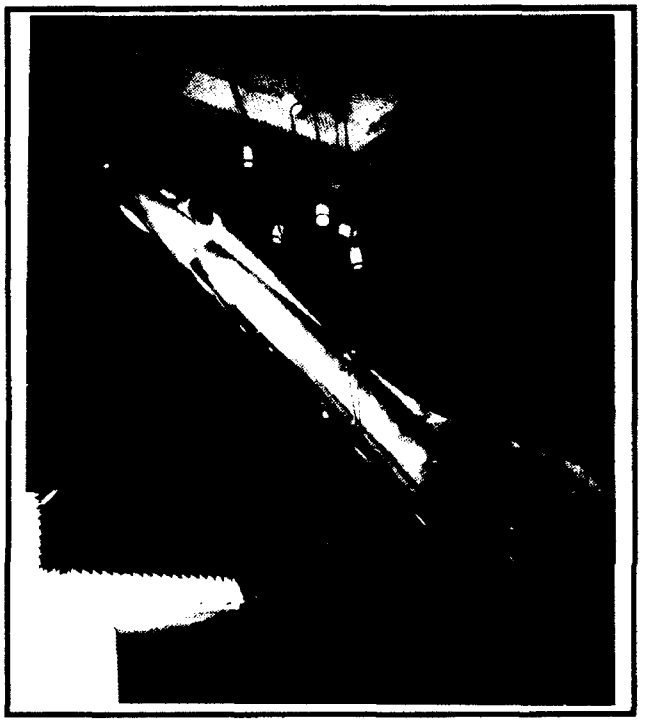
- electronic warfare,

- scientific and technical computation, and

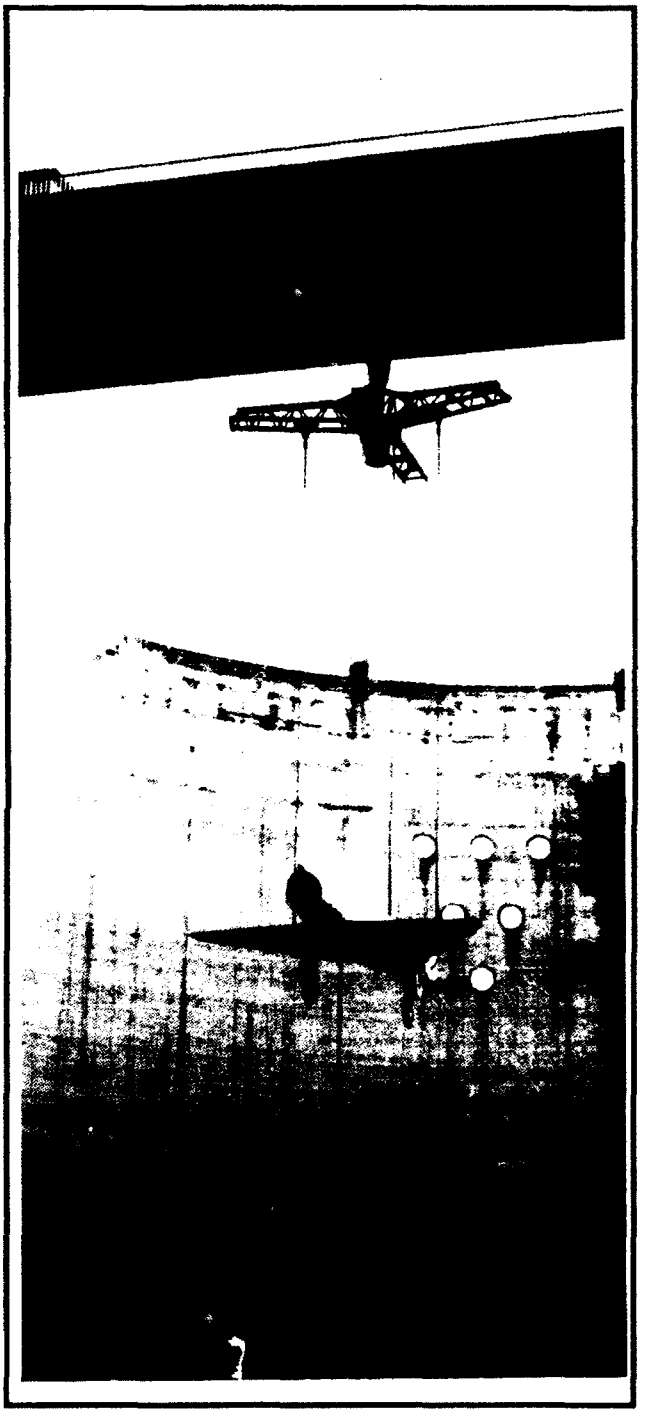
Air Combat Simulator

- electronic and data processing security,

- measurement, analysis and storage of radar and optronic signatures.



Mirage III Model in Anechoic Chamber of CELAR

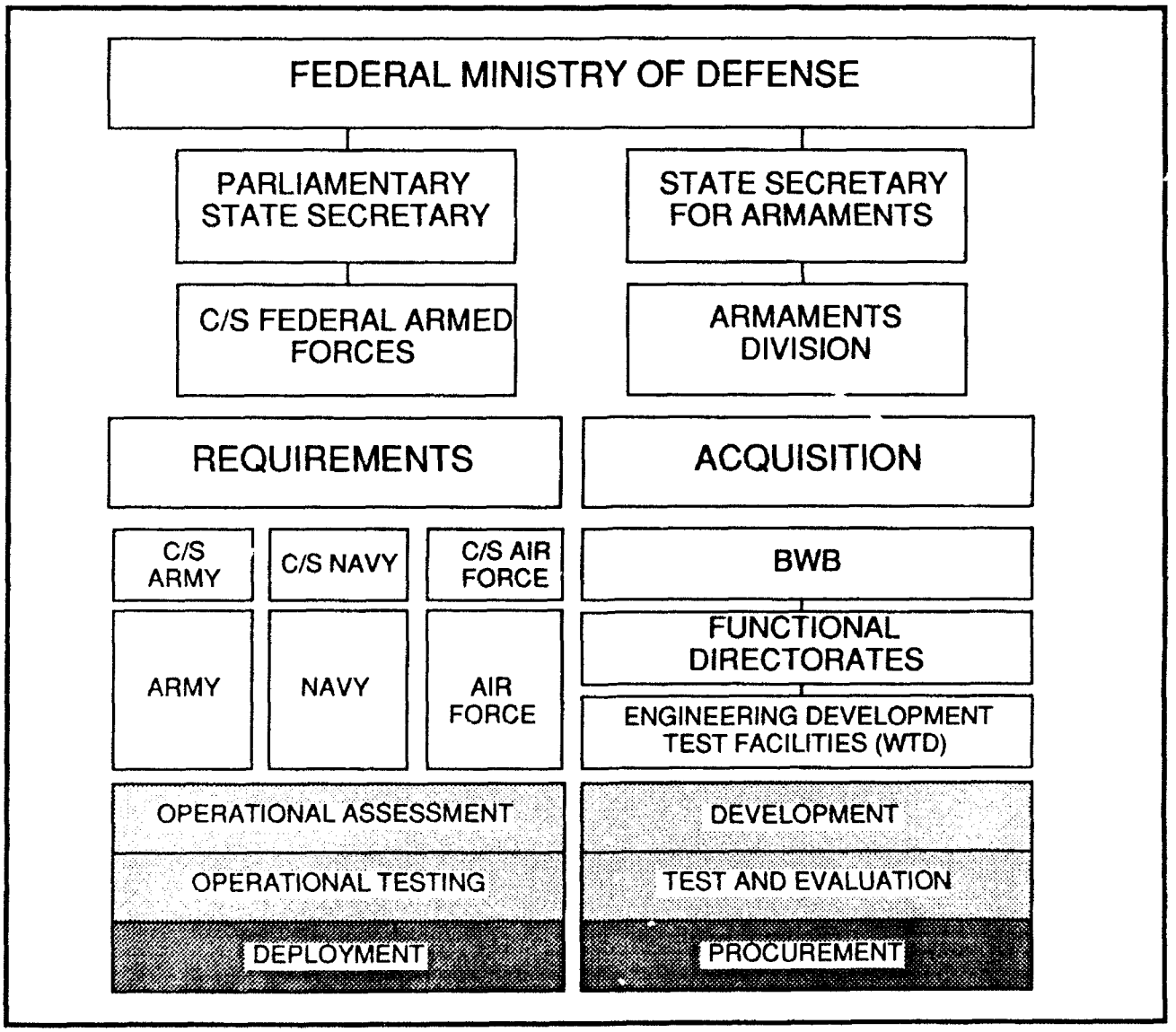


Testing Radiation Patterns

GERMANY

GERMANY

The organization of The Federal Ministry of Defense is shown in a simplified form to illustrate requirements and acquisition functions. Under civilian control, the various Armed Forces provide weapon requirement information. This information influences decision making concerning military systems acquisition. Through the State Secretary for Armaments and the Armaments Division, the Federal Office for Military Technology and Procurement (the BWB as it is called from its German initials) is responsible for the procurement and engineering evaluation of equipment and weapons for the German military forces. The BWB is the sole designated contact for development, production and procurement. In actual practice, industry works closely with the Armed Forces in determining defense requirements.



FRG Systems Acquisition Organization

GERMANY

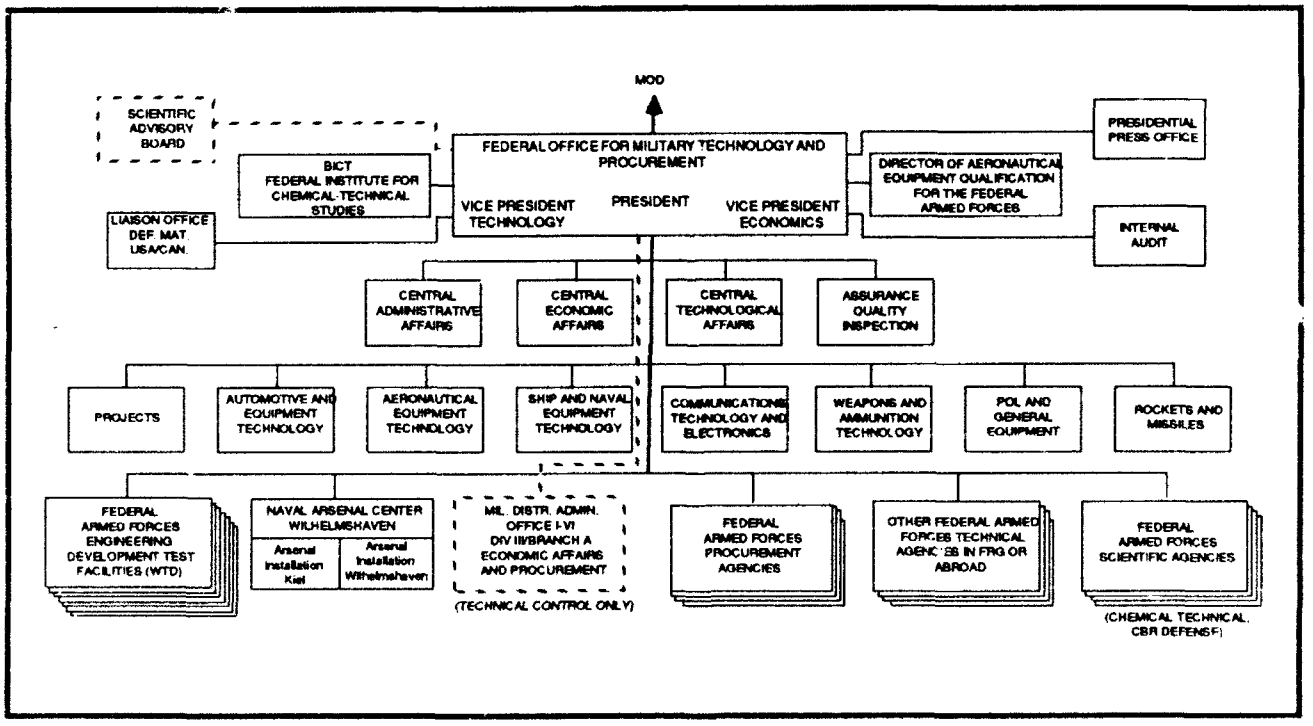
BUNDESAMT FUER WEHRTECHNIK UND BESCHAFFUNG (BWB)

MISSION

The Federal Office for Military Technology and Procurement, the BWB, is the central agency of the government responsible for technical development, acquisitions, and testing of equipment for all branches of the Armed Forces (Bundeswehr), based on the orders received from respective departments of the Department of Defense (BMVg).

LOCATION AND ORGANIZATION

The central headquarters of the BWB is located in Koblenz. It is organized in major sectors, special projects, specialties departments and central administration. The organization of test facilities is illustrated below.



BWB Test Facilities Organization

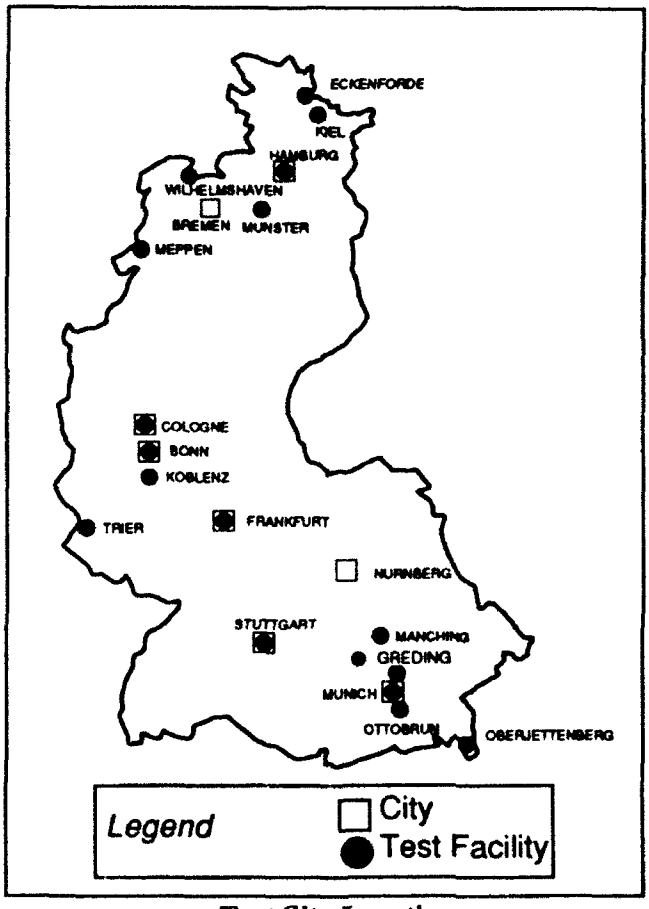
GERMANY

CAPABILITIES

The capabilities in the acquisitions sector extend from arrangement of national and international acquisition contracts to oversight of decentralized acquisitions through the defense district administrations located throughout the FRG. The BWB has no production capabilities, but its engineers are involved in development of technical specifications. They also monitor private sector development and manufacturing on location.

TESTING

The equipment testing is carried out at Engineering Development and Test Facilities (Wehrtechnische Dienststellen), located throughout the FRG, which are under direct administrative and technical control of the BWB.



Test Site Locations

Address:
Bundesamt fuer Wehrtechnik
und Beschaffung
Konrad Adenauer - Ufer 2-6
5400 Koblenz 1

GERMANY

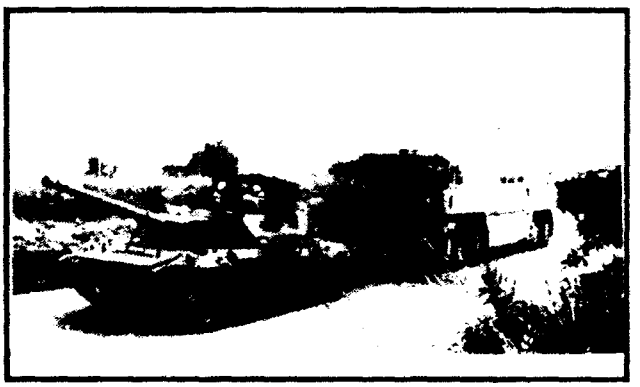
Wehrtechnische Dienststelle 41 d. BW. fuer Kraftfahrzeuge und Panzer Trier/ Grueneberg (WTD 41)

MISSION

Conduct technical testing of all military wheeled and tracked vehicles focusing on stress limits, function, combat readiness, reliability and maintainability.

LOCATION

At the outskirts of Trier on the western border with Luxembourg.



Dynamometer test vehicle with MBT Leopard

CAPABILITIES

Topography : In the Mosel river valley of the Rheinland Pfalz, Test Site-41 provides a full range of actual and simulated operating terrain from hot, dusty, to cold, snow covered, hilly areas.

Ranges:

General Test Area. Motor vehicles are driven cross country and on highway courses in various cycles under varied conditions to determine the full range of vehicle capabilities. The range includes:

- Deep water fording basin, 130 x 16 meters for wheeled and tracked vehicle deep fording and amphibious evaluation, diving and swimming tests.
- Gradeability Slopes: 450m of 20, 30, 50, and 60% slopes.
- Belgian Block Course: 450m of uneven laid granite blocks forming an undulating surface.
- Washboard: 600 meter of sine wave course, with a series of periodic bumps with an amplitude of +/- 25mm.
- Corrugated Course: Sine waves in direction of travel at 30 degree angles.
- Sine Course: wave length 7 meters, Amplitude ± 100mm.
- Sine Course: wave length 4 meters, Amplitude ± 150 mm.
- Obstruction Course: right and left course halves displaced 180° amplitude steadily decreases towards center.

Facilities:

Climatic Test Chamber: Temperature ranging from -40c to +90c, and relative humidity 10-98%.

Chemical laboratory to evaluate fuels.
Human Factors Laboratory to evaluate man/machine interfaces, communication, function analysis stress.
Engine Test Cells.
Transmission Test cells.
Calibration Laboratory.
Photographic Laboratory.
Mechanical and Electrical Workshops.
Rubber (Tire & Track Pad) Test Lab.
Motor Vehicle Workshops.

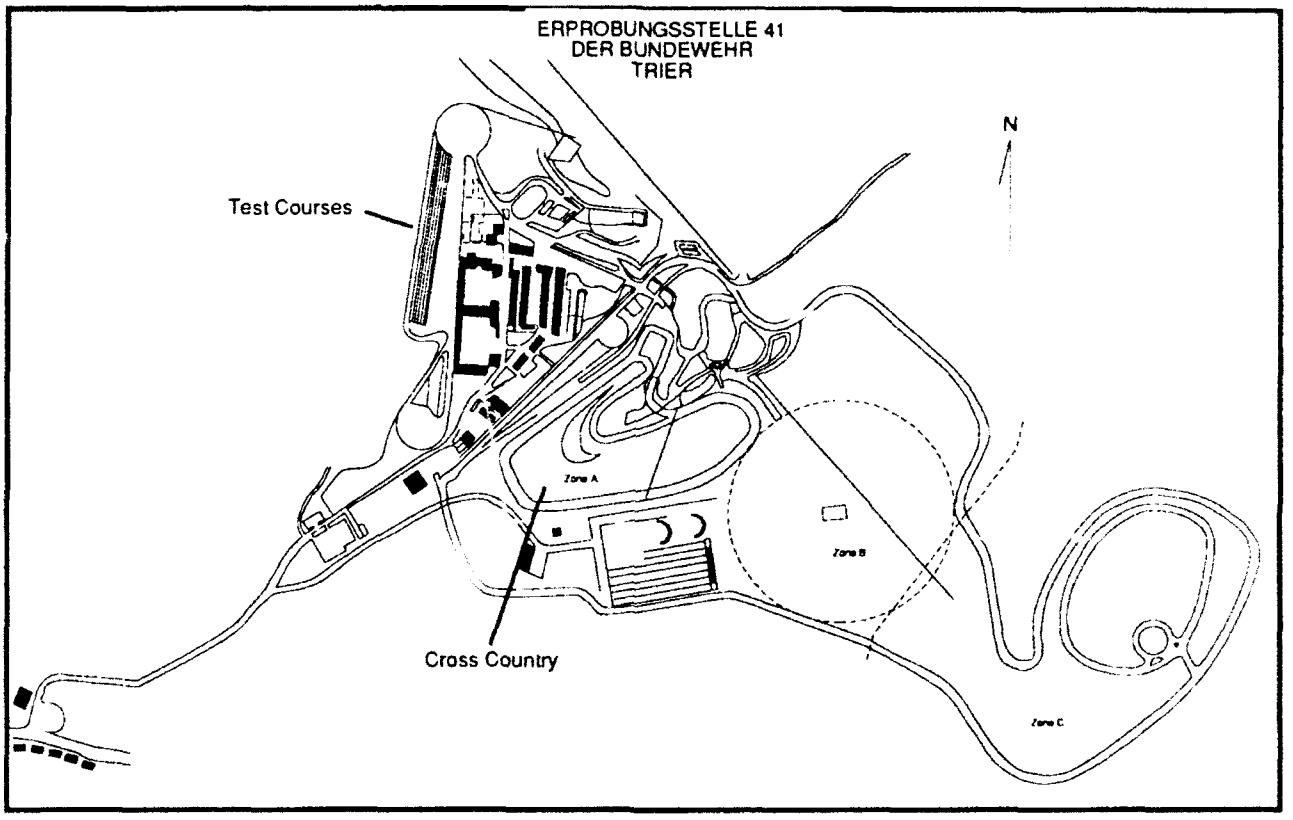
GERMANY

TYPICAL PROJECTS SUPPORTED

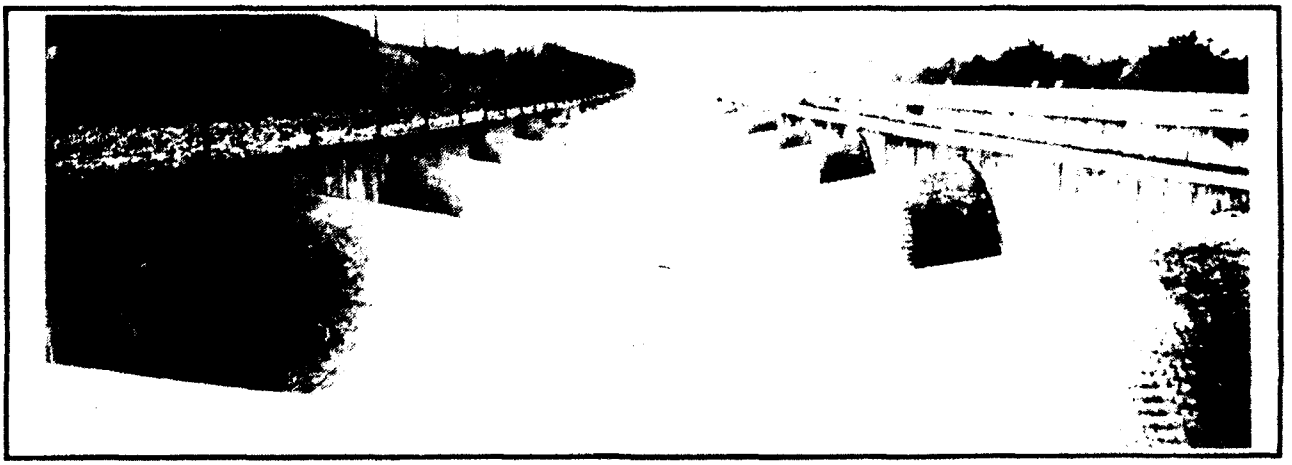
Leopard 2 Battle Tank.
Leopard 1
Light Armored Vehicles
Personnel Carriers

ADDRESS

Wehrtechnische Dienststelle 41 d. Bw.
fuer Kraftfahrzeuge und Panzer
Grueneberg
55000 Trier, West Germany



BWB Test Site 41-Trier



Vehicle Test Track at Trier

GERMANY

Wehrtechnische Dienststelle 51 d. Bw. fuer Pioniertruppengeraet und Sondertechnik Koblenz (WTD 51)

MISSION

Research, Development, Test and Evaluation of military engineer equipment.

LOCATION

Approximately 70 km southeast of Bonn at the junction of the Mosel and Rhein rivers.

CAPABILITIES

Topography : Koblenz is the site of BWB headquarters and three separate test facilities.

Metternich. The main site on the west bank of the Mosel. The 14+ acre area is close to the residential area of Koblenz.

Ruebenach. Seven km southwest of Metternich, the site occupies 13 acres, 5.5 of which are fenced and the remainder open fields surrounded by the Ruebenach forest.

Karthause. Four and one half km south of Metternich on the east side of the Mosel, the site occupies 23.5 acres ideally suited for testing and evaluating all elements of pipeline construction.

Ranges/Facilities :

Metternich. Facilities for testing bridges and bridging equipment, ferries, boats and floating or floatable vehicles.

- A "bridge pit" in addition to the Mosel and Rhein rivers provides suitable environments for testing amphibious concepts, operations and equipment.

- A ring canal to test water propulsion under controlled conditions.

Ruebenach. Facilities for testing motorized equipment over various terrain features.

- Graded roadways of 10%, 15% and 30%.
- Crane test area.
- 300 yards of railroad track for testing railroad flatcar loading/unloading.
- Gravel pit to test excavation equipment.
- Chemical lab for soil classification and analysis.

Karthause. Facilities for testing functionality of all elements of pipeline construction and maintenance.

- Pump testing to 100 bar and 300 m^3/hr
- Burst testing pipelines to 600 bar.
- Fuel laboratory.

Workshops for repair and maintenance of vehicles, equipment and instrumentation.

Resources:

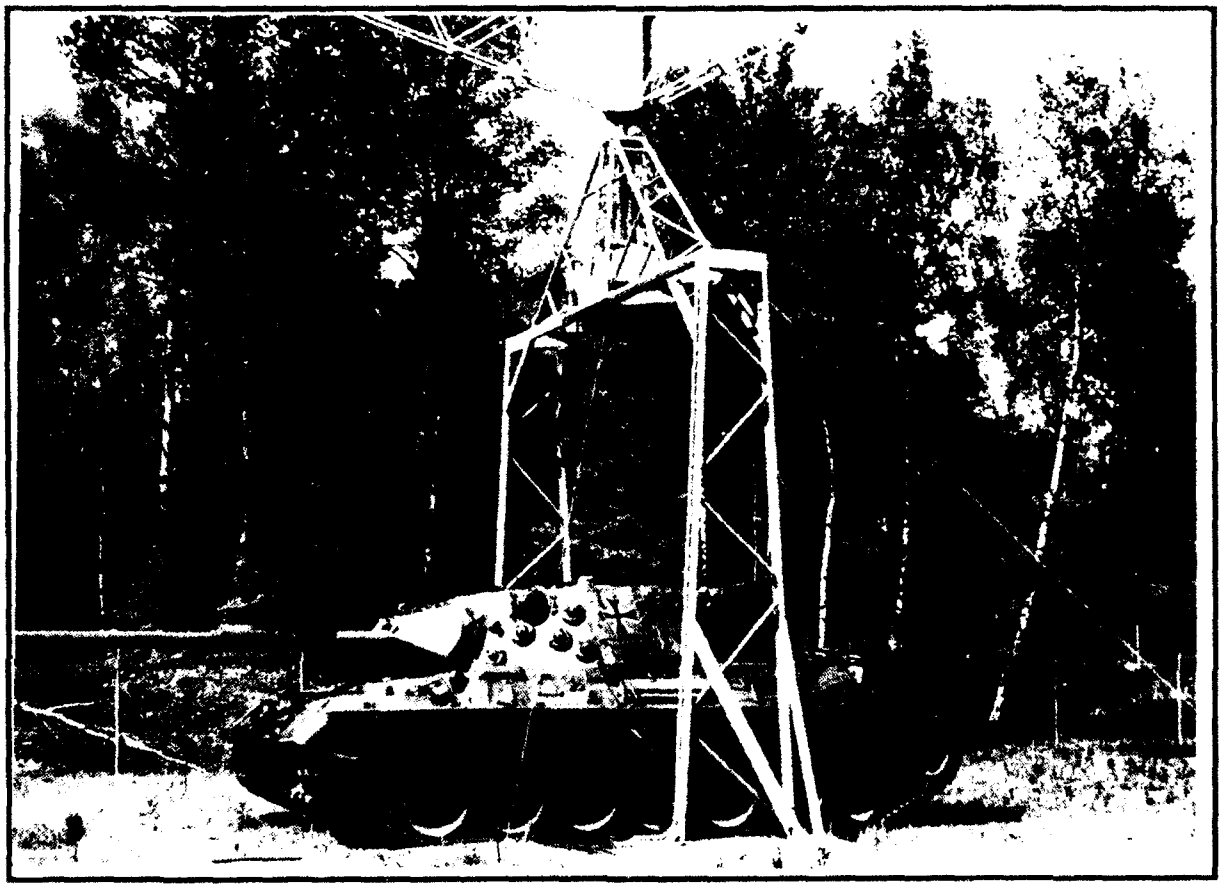
Instrumentation. (partial list)

- Mobile, programmable, multi-point measurement unit
- Telemetric unit
- PCM measurement unit
- Tension torsion measurement unit
- Static vibration evaluator
- Sonic optimeter
- Multi-point temperature measurement
- Electro lab
- VOE standards test equipment
- Insulated test rooms
- Frequency analyzers
- Phosphometer
- Jam frequency measuring device

- Battery testers
- Pulsar to test dynamic fatigue
- Field strength measurement unit
- Electric potential measurement unit.

ADDRESS

Wehrtechnische Dienststelle 51 d. Bw.
fuer Pioniertruppengeraet
und Sondertechnik
Winningerstrasse 15
5400 Koblenz, West Germany.



Tank Evaluation Facility

GERMANY

Wehrtechnische Dienststelle 52 d. Bw. fuer Sprengmittel und Sondertechnik Oberjettenberg (WTD 52)

MISSION

Conduct tests and evaluations of a wide range of air/land warfare systems and techniques.

LOCATION

In the Bavarian Alps approximately 18km northwest of Berchtesgaden in a valley at the foot of the Reiteralpe.

CAPABILITIES

Topography : WTD-52 consists of three distinct geographic environments:

The Valley Area. About 86 acres generally snow covered from mid December - March with low temperatures to -15°C.

The Underground Facility. A tunnel complex of approximately 3km in length.

The Elevated Plateau. A test area of approximately 4.5 km^2 and 1700m above sea level on the Reiteralpe. Winter temperatures to -20°C in rugged mountain areas.

Ranges :

The Valley range consists of administrative buildings, laboratories, workshops and test stands to support tests of fire hazardous materials, structures in high wind and shock conditions and combat engineering techniques.

The Tunnel complex provides cross sections between 13m^2 and 78m^2 for explosive engineering facilities, test stands and laboratory rooms. Pressure doors facilitate isolation of various laboratory areas for conduct of several tests simultaneously under differing environmental conditions. A wide range of temperature, humidity and pressure conditions is available. The Tunnel accommodates vehicles including tanks.

Valley Area

The high plateau supports tests of military systems under realistic combat conditions in a mountainous area. Live fire testing and training in handling cased and uncased munitions for mortars and artillery are conducted under various climatic conditions. The range is generally snow covered from mid November to May. Winter maneuvers and camouflage are evaluated.

Facilities:

A burning range for testing fire hazardous materials.

Test structures for evaluating systems in high wind and shock conditions.

Helo pad.

Laboratories and test areas for combat engineering systems.

Cable car between the Valley and the Reiteralpe plateau with capacity for 15 persons or 2000kg of cargo. The 1000m difference in elevation is traveled by the car in about 10 minutes.

Resources:

Combat Engineering Equipment
Mine Laying, Detection and Clearing Devices
Special Equipment for Winter/Cold Operations
Camouflage and Deception Materials in the Visual, Ultra Violet and Infrared Ranges
Antenna Support Structures
Construction Materials
Vibration Platforms

TYPICAL PROJECTS SUPPORTED

Munitions for field artillary and mortars. Cased and uncased ammunition.

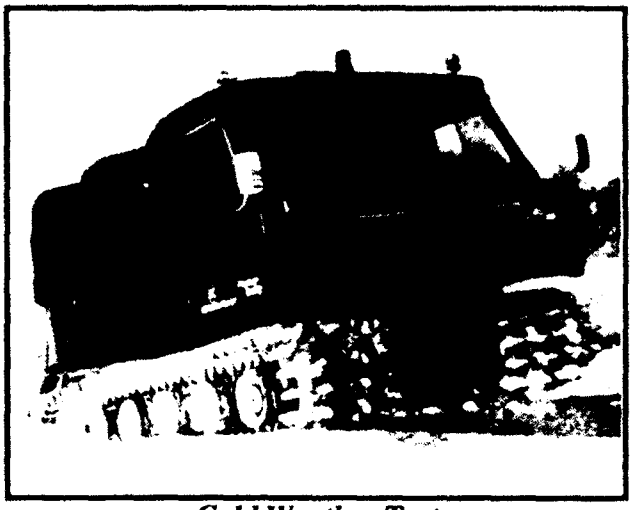
Combat engineer equipment and techniques.

Camouflage techniques and materials.

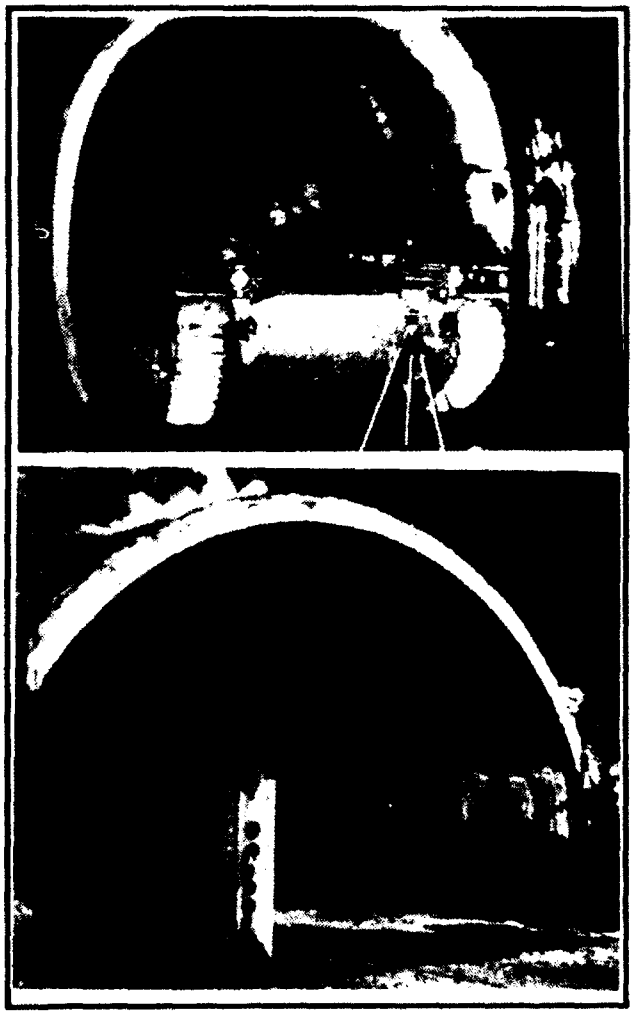
Winter maneuvers.

ADDRESS

Wehrtechnische Dienststelle 52 d. Bw.
fuer Sprengmittel und Sondertechnik
Oberjettenberg D8230 Schneizlreuth, West Germany.



Cold Weather Test



Test Tunnels

GERMANY

Wehrtechnische Dienststelle 61 d. Bw. fuer Luftfahrzeuge Flugplatz Manching (WTD 61)

MISSION

To support the German military forces by overseeing the development of aircraft, aircraft systems and aircraft support equipment.

LOCATION

In the southeast sector of the Federal Republic of Germany, approximately halfway between Munich and Nurnberg near the city of Ingolstadt.

CAPABILITIES

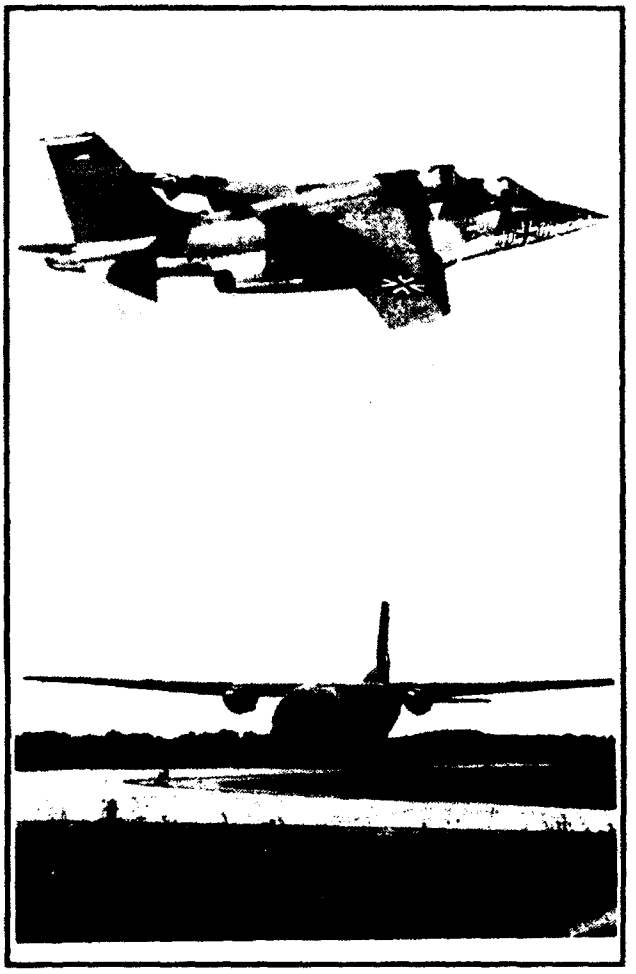
Aircraft and aircraft system test and evaluation facilities for the full range of combat and support aircraft and aircraft systems, e.g., the TORNADO, the European Fighter Aircraft forecast to be operational in 1997, the F4F improvement program, the X-31 technology demonstration, the C-160 TRANSALL transport aircraft , the Future Large Aircraft program, the EGRETT electronic surveillance platform and the anti-radiation drone DAR. Aircraft armament modernization efforts include seeker-head improvements of the SIDEWINDER AIM-9 air-to-air missile, a low-level anti-tank weapon and new weapons for use against stationary and mobile ground targets.

General technical trends of interest to evaluators include the following:

New materials, specifically those moisture and ultraviolet resistant.

Stealth technology developments to minimize possibilities of detection by radar and infrared systems.

Single-crystal and fiber-strengthened ceramics for engine use to allow higher engine temperatures and lower fuel consumption.



Representative Test Aircraft

New modular avionics equipment with standard connectors.

Measures to increase reliability.

Miniaturization of components.

Fire-and-forget guided missiles.

ADDRESS

Wehrtechnische Dienststelle 61 d. Bw.
fuer Luftfahrzeuge
Flugplatz
8072 Manching, West Germany

Wehrtechnische Dienststelle 71 d. Bw. fuer Schiffe und Marinewaffen Eckernfoerde (WTD 71)

MISSION

To support the German military forces by providing ship and naval weapon systems test and evaluation services including expert personnel.

LOCATION

In the northern part of the Federal Republic of Germany northwest of Kiel.

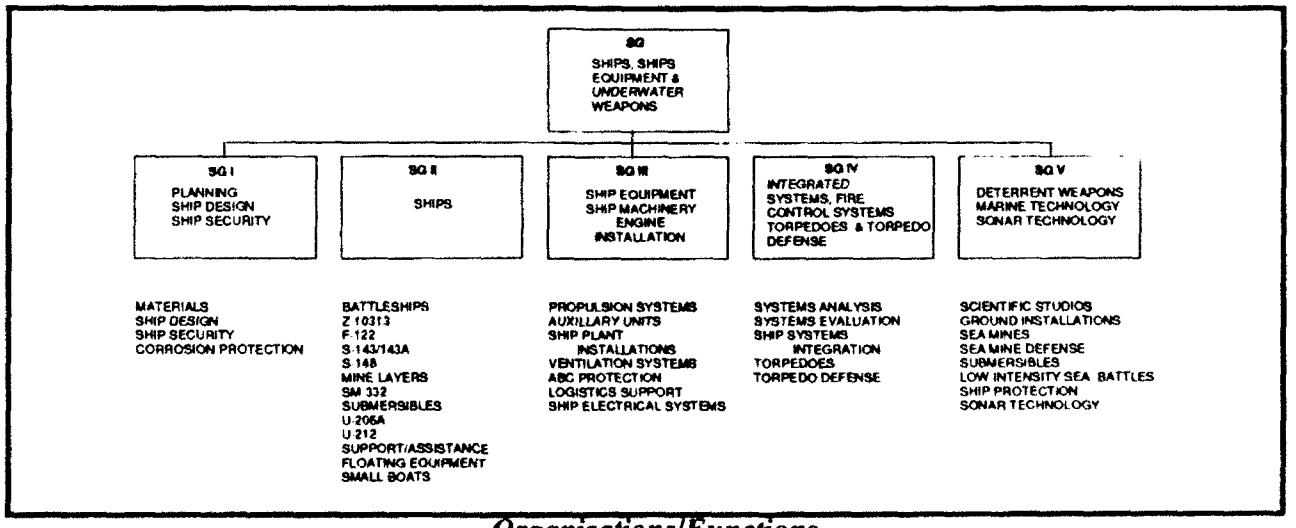
CAPABILITIES

Test and evaluation facilities are provided for a wide range of surface and subsurface combatants, e.g., F-122 Bremen-Class frigates, NATO-Frigate 1990 (NFR-90), Class-128 Fast Boat improvements (new fire control radar), Class 206 submarine improvements (new weapons systems and torpedoes), Class 212 submarine improvements (new storage and hybrid propulsion systems), and support of the new SM-343 Class and MJ-332 Class minesweeper boats. Other systems include the missile defense system, RAM; the anti-ship KORMORAN-2 missile carried aboard the TORNADO aircraft; the supersonic anti-ship missile, ANS, and new sea-mine systems.
See illustration below

Submarine Magnetic Measurement

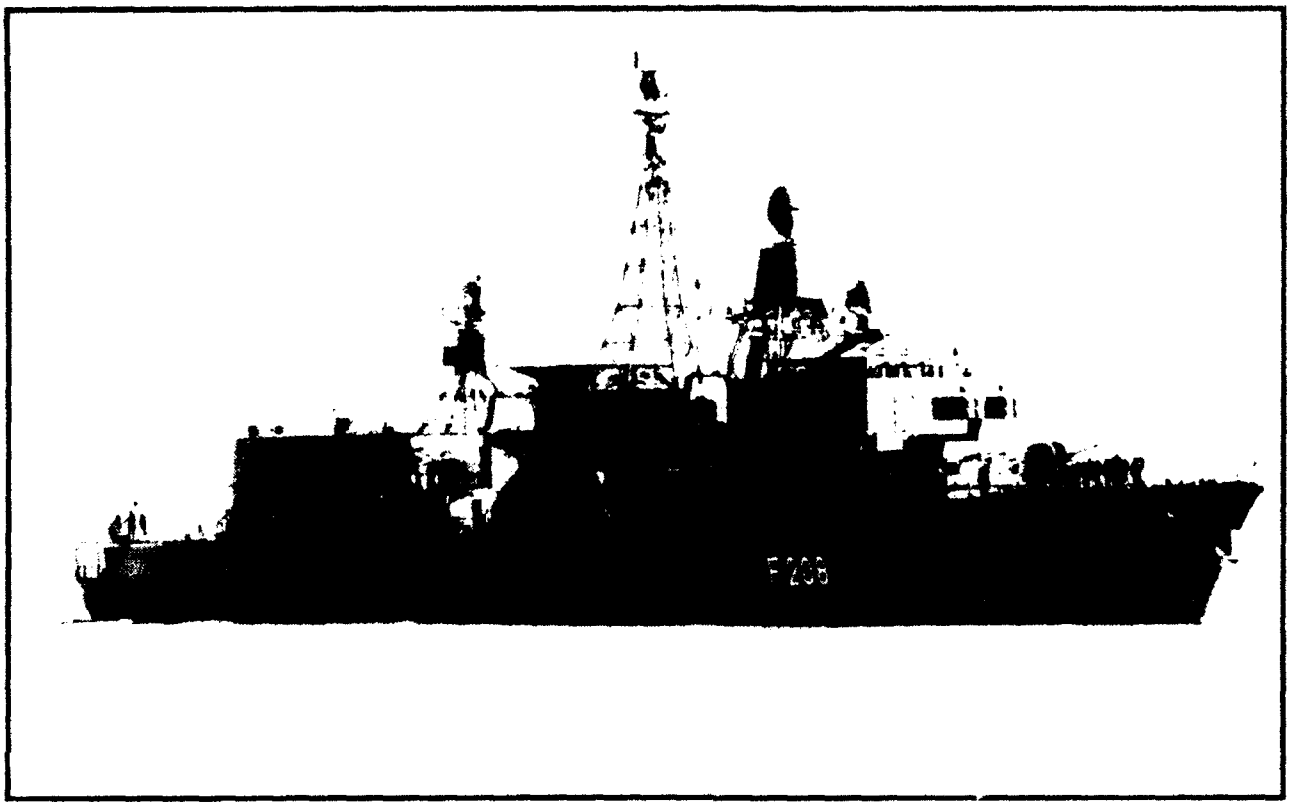
ADDRESS

Wehrtechnische Dienststelle 71 d. Bw.
fuer Schiffe und Marinewaffen
Berliner Strasse 115
2330 Eckernfoerde, West Germany

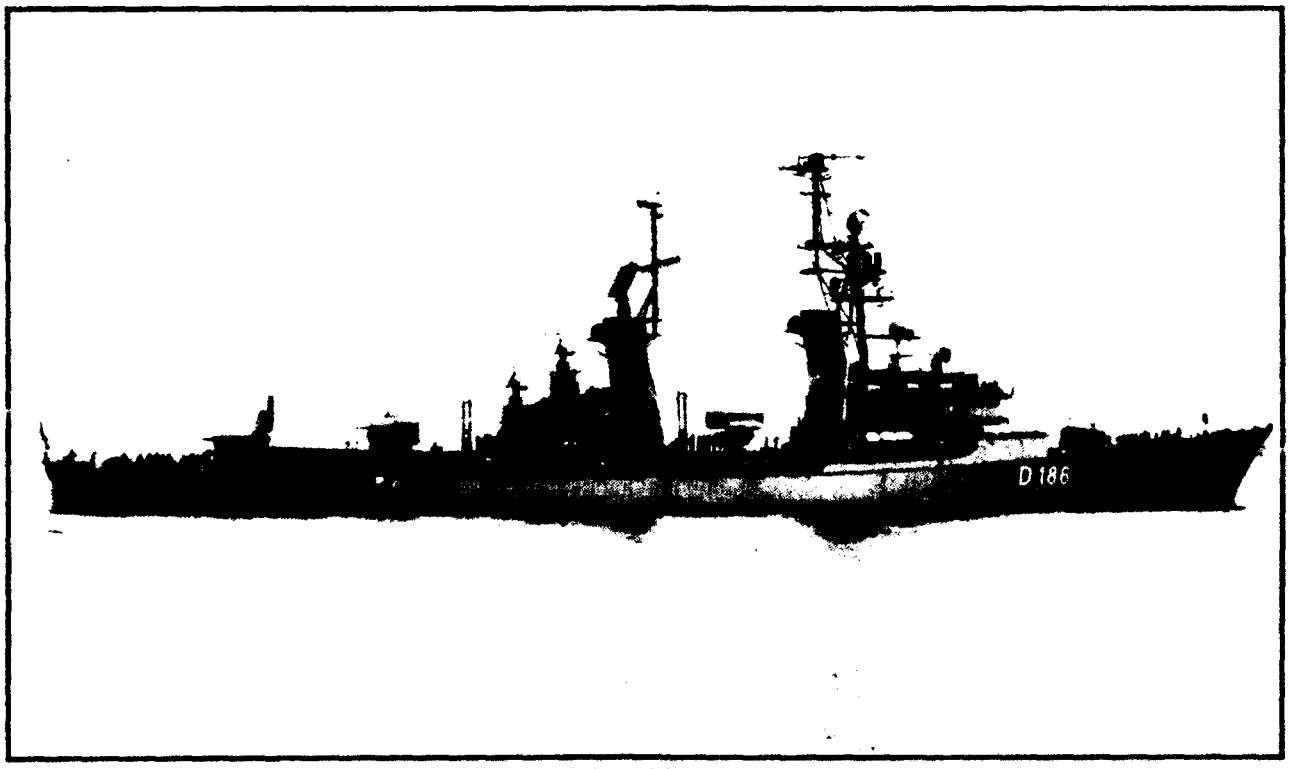


Organizations/Functions

GERMANY



Niedersachsen



Moelders

Wehrtechnische Dienststelle 81 d. Bw. fuer Fernmeldewesen und Elektronik Greding/ Kalvarienberg (WTD 81)

MISSION

Evaluate suitability and servicability of electronic and communications equipments developed by private industry under contract to BWB.

Develop guidelines and test objectives for each potential acquisition.

LOCATION

In Greding, approximately 70Km north of Muenchen, on the Muenchen-Nuernberg autobahn.

CAPABILITIES

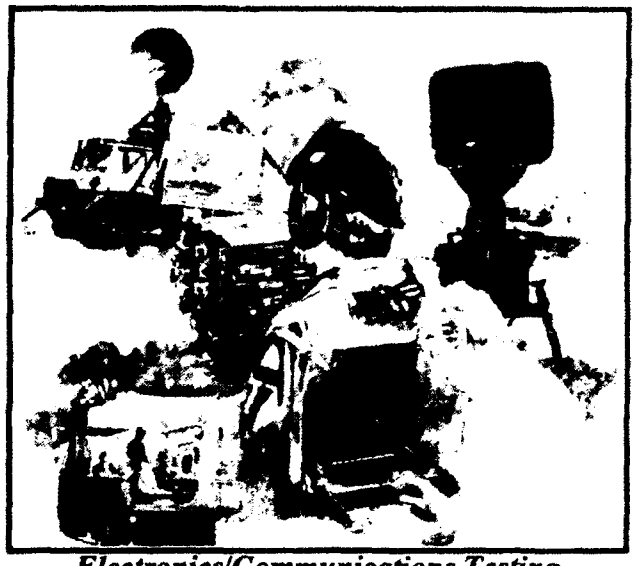
Topography: One hundred acre mountain plateau, 500 meters above sea level. Testing may be conducted on surrounding military and commercial property.

Ranges: Most testing is conducted in laboratories. Projects with extensive system test requirements or unique terrain, climate or other environmental requirements are usually conducted abroad in the USA, Canada, France, UK or Italy at test sites providing the required environmental conditions.

Facilities: Europe's largest and most modern Electromagnetic Compatibility (EMC) test center. Site includes a helicopter landing pad and rotating platform for rotational movement of systems in test.

Over 40 different environmental test units located in various laboratories providing a wide range of climatic conditions. The labs routinely test, measure and evaluate systems for:

- operational readiness,
- operational safety,
- operator/maintainer suitability,



Electronics/Communications Testing

- electromagnetic compatibility,
- resistance to jamming,
- reliability,
- environmental suitability,
- system performance, and
- affordability.

Laboratories are supported by the Defense Technical Computer Center South.

Wood and metal shops and vehicle maintenance facilities are available for support.

Resources:

Instrumentation radio, radar, optical, acoustic and infrared test equipment, automated measurement and recording equipment.

TYPICAL PROJECTS SUPPORTED

Equipment intended primarily for land warfare vehicles (tanks, armored personnel carriers, etc.).

ADDRESS

Wehrtechnische Dienststelle 81 d. Bw.
fuer Fernmeldewesen und Elektronik
Kalvarienberg
8547 Greding, West Germany

GERMANY

Wehrtechnische Dienststelle 91 d. Bw. fuer Waffen und Munition Schiessplatz Meppen (WTD 91)

MISSION

Test and evaluation of weapon systems and ammunition ranging from small arms to large caliber guns and missiles and fire control systems for land warfare capability.

LOCATION

At Meppen, northeast of the intersection of highways B70 and B402. Approximately 130km southwest of Bremen.

CAPABILITIES

Topography: Sixty square miles of usable test area. Generally rolling plain of the low lands south of Bremen.

Ranges:

Firing ranges involve contracts with property owners with some restrictions. Includes:

- environmental testing of ammunition, and
- rocket and tank/artillery range firings.

Facilities:

Test stands, laboratories and workshops available for:

- test and evaluation of munition systems and components,
- instrument evaluation and certification, and
- test and evaluation of meteorological instruments.

General Service Department supports firing tests and schedules construction and services.

Measurements Department provides for observation/ recording of ballistic tests and maintenance and calibration of instruments.

Chemical/Technical Lab directs tests and simulations, evaluation of explosive materials and functional experiments.

Data Processing Department provides computer analysis of test data.

Department of Planning and Coordination.

Resources/Instrumentation:

Photo Detectors
Tracking Radar
Velocity Radar
High Speed Camera
Electronic Timers
Flash X-Ray
Photography
Electromagnetic Sensors
Spectrum Analyzers

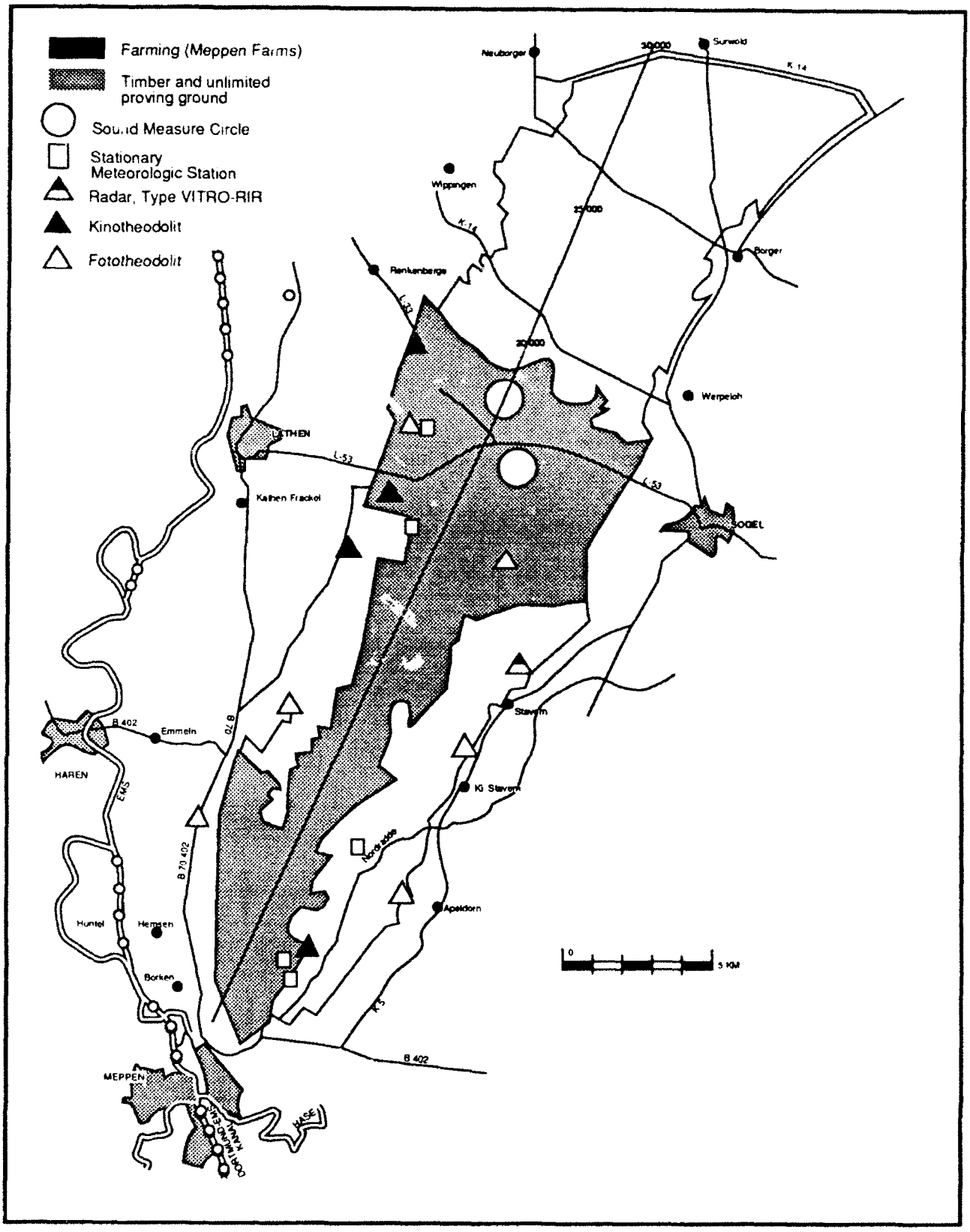
Targets- Hard and soft live fire targets, automotive and ground structures.

TYPICAL PROJECTS SUPPORTED

Tank Weapons
Artillery
Night Vision Aids

ADDRESS

Wehrtechnische Dienststelle 91 d. Bw.
fuer Waffen und Munition
Schiessplatz
4470 Meppen, West Germany



Firing Range - 91 Meppen

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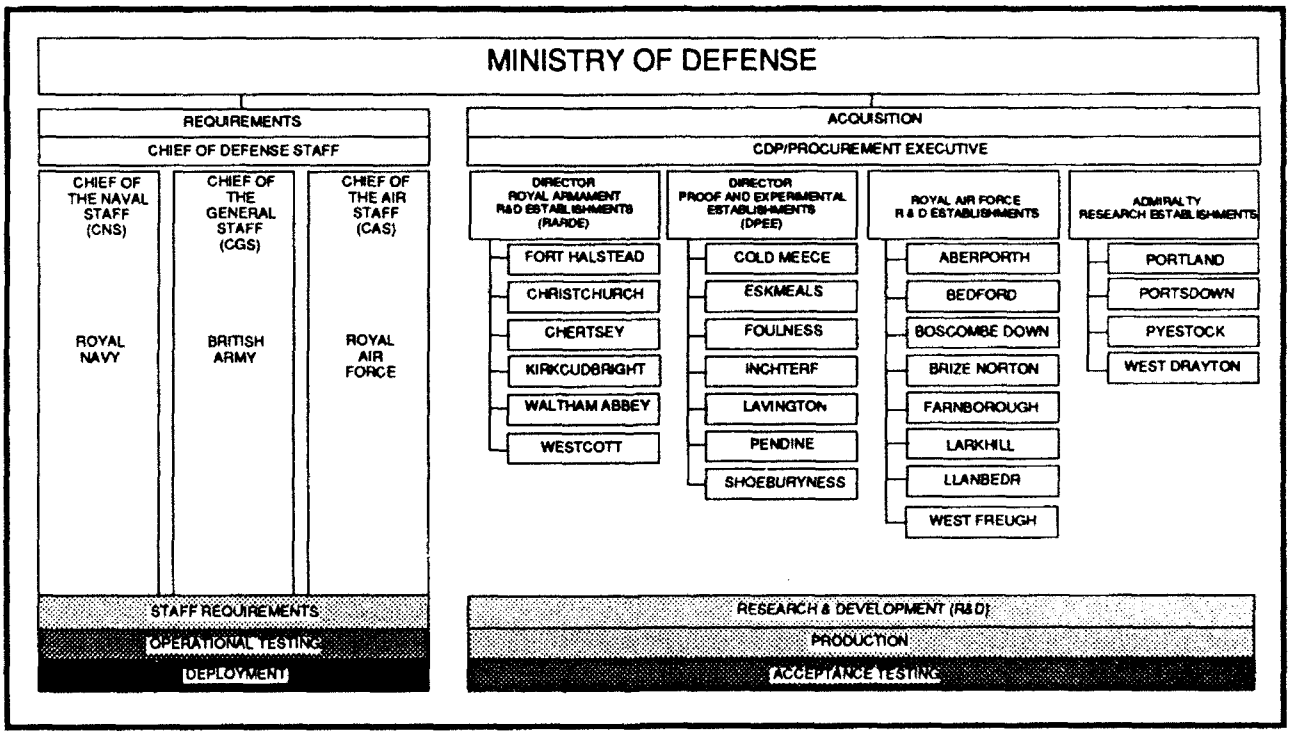
UNITED KINGDOM

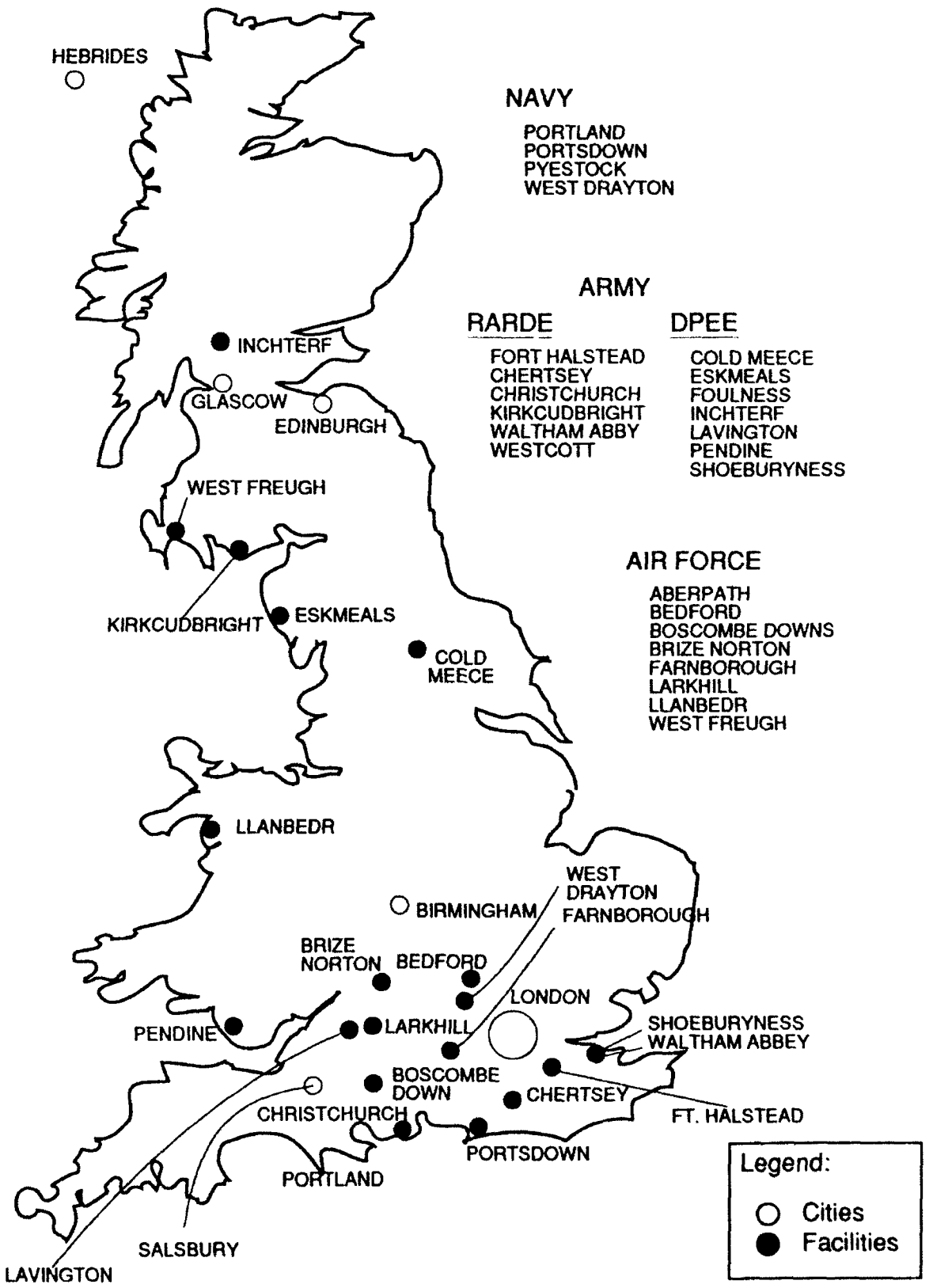
UNITED KINGDOM

The Chief of Defense Procurement (CDP) is directly responsible to the Secretary of State for Defense for all weapon systems acquisitions. His organization is administratively responsible to the Permanent Undersecretary of State, the senior civil servant in Ministry. The CDP is the principal advisor to the Secretary of State for defense and the Chiefs of the Defense Staff, and is specifically responsible for international collaborative efforts. Test and Evaluation (T & E) is conducted as an integral part of the acquisition process which Service personnel present at all stages of testing. The Project Director, counterpart of the U.S. Program Manager, is responsible for test and evaluation of this project. User Service personnel are fully involved throughout the T & E process. The weapon systems acquisition process is initiated within the CDP organization with the establishment of Central Committees who review requirements, approve start-up and review progress of major programs. The Permanent Undersecretaries of State exercise administrative oversight while the Chief of Defense Staff is involved in all aspects of procurements, including definitions of operational requirements. The folowing figure highlights the functional organization and site locations.



United Kingdom Systems Acquisition Organization

U.K.

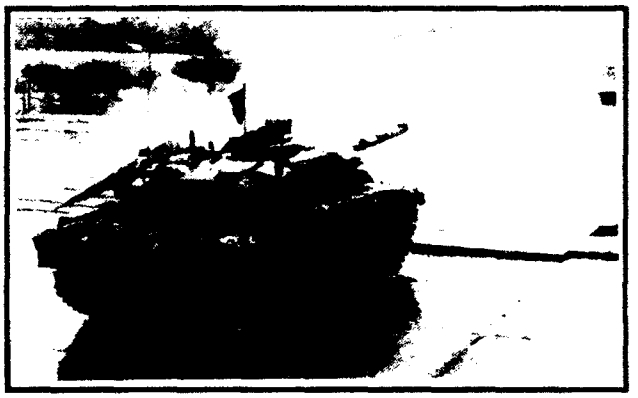


U.K. MoD R&D Facilities Locations

ROYAL ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (RARDE) FORT HALSTEAD

MISSION

The Royal Armament Research and Development Establishment (RARDE) is the Ministry of Defense's center for research and development in the fields of weapons, ammunition, land vehicles and armor for the three services, and computers, information systems, assessment, military bridges and engineer equipment for the Army. The Establishment has a civilian staff of some 2500, including 1000 scientists, engineers and technicians covering a very wide range of disciplines and technologies, plus 200 officers and other ranks mainly from the Army.



Challenger on Firing Trials

LOCATION

The Headquarters of the Establishment is RARDE, Fort Halstead, near SEVENOAKS, Kent TN14 7BP.

The Establishment has four other main sites as follows: RARDE, Chobham Lane, CHERTSEY, Surrey KT16 OEE; RARDE, Barrack Road, CHRISTCHURCH, Dorset BH23 2BB; RARDE, Powdermill Lane, WALTHAM ABBEY, Essex EN19 1AX; RARDE, Girdstingwood, KIRKCUDBRIGHT, Scotland DG6 4QZ. In addition, the Rocket Propulsion Establishment (RPE) based at WESTCOTT is responsible for all guided missile propulsion systems.

CAPABILITIES

Researh and Defense activities at RARDE cover a wide spectrum from speculative long term research which can last many years, to testing and evaluation in direct support of equipment procurement and acceptance by the Minister of Defense (MoD). A very comprehensive range of test and trials facilities has been established to support these R and D functions. In line with the Government drive for value-for-money, RARDE is now actively promoting the use of these facilities by industry and other organizations for defense or civil work at competitive rates. This activity is known as the Facility Management and Marketing Initiative (FMMI). There is a highly competent staff of professionals and technicians experienced in planning, designing, implementing, analyzing, evaluating and reporting on tests, trials and experiments in the facilities.

Ranges:

Enclosed ballistic ranges for guns up to 40mm, with full instrumentation, high speed and flash X-ray photography.

Facilities:

Environmental Testing

- A range of environmental cabinets, humidity chambers, altitude cabinets, salt spray, ultraviolet exposure, thermal

cycling and thermal shock equipment, some with the ability to test explosive stores.

- A range of hydraulic and electromagnetic vibrators, shock and bump test equipment and transport simulators for both explosive and inert stores.

Mechanical and Structural Testing

- High Pressure (800N/mm²) hydraulic tube testing facility (both static and fatigue).
- High strain-rate tensile/compressive loading machine (500kN maximum load, 2m/s maximum ram speed).
- Drop test facilities for both explosive and inert stores.
- Computer/servo controlled hydraulic actuator (0.6m stroke) for fatigue and wear testing.

Explosives Facilities

- Experimental manufacture and testing facilities for propellants, including closed and open vessel firing facilities.
- Explosives firing facilities with instrumentation, high speed cameras and flash X-ray equipment.
- Energetic materials safety test equipment.
- Facilities for the determination of low strain-rate mechanical properties of explosives.
- Water tower, emplacements, drop towers and pads, with suitable instrumentation for the testing of pyrotechnic devices.
- Mixing, filling and firing equipment for initiators and pyrotechnic stores.

Wind Tunnels

- A 457mm tunnel operating at velocities up to 45.8m/s.
- A 127mm tunnel operating at Mach 5-6 for 10 seconds.

Non Destructive Testing

- A linear accelerator @ 5 Mv, 8 Mv and 12 Mv, with X-ray cell.
- A variety of laboratory and portable X-ray equipments from 50 kV cp to 420 kV cp.
- Computerized Axial Tomography (CAT) equipment incorporating a 420 kV cp X-ray set.
- Gamma-ray equipment: containers for 30 Ci Co 60 and 30 Co Ir 192.
- Neutron radiography: a linear accelerator at 12 Mv with a secondary Be/Du target.
- Image intensifiers with closed circuit television (CCTV) for dynamic radiography and fluoroscopy.
- Computer image enhancement techniques.

Materials Facilities

- Various spectroscopic techniques including Laser Raman, X-ray fluorescence, Fourier transform IR and NMR.
- Mass spectrometry.
- Chromatographic methods, including HPLC GC ion exchange.
- Fusion techniques for the analysis of impurities in metals.
- Chemical analysis equipment.
- Optical and electron microscopes.

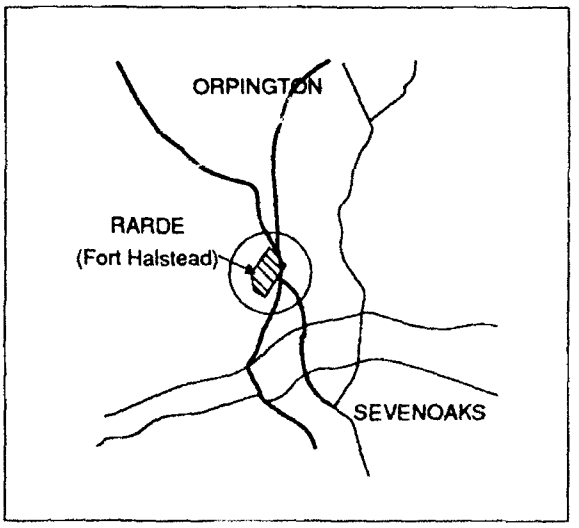
Special Test Facilities

- Hypervelocity projectile launcher (6000 m/s).
- Gun recoil simulators.
- Proximity fuze hoist.
- High altitude tanks (for explosive stores).
- High enthalpy blast simulator.
- Daniels high speed spinner (30,000 rpm) and Unichrome high speed spinner (90,000 rpm), for shell fuze testing.

POINT OF CONTACT

Director RARDE
Fort Halstead, Kent TN14 TBP
Tel: Knockholt (0959) 32222

Facilities Exploitation Manager
RARDE
Chobham Lane



RARDE Headquarters

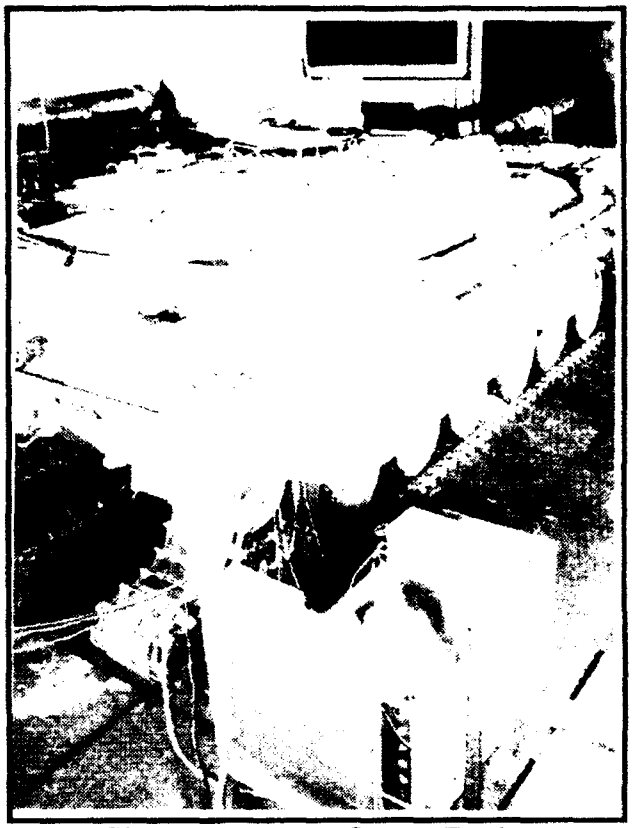
ROYAL ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (RARDE) CHERTSEY

MISSION

Chertsey is responsible for technical advice, feasibility studies, concept designs and evaluation of all prototype vehicles and vehicle borne weapons systems for the services, and for engineering and bridging equipment. Development trials are carried out to provide designs, both from the technical and user aspects, after which, equipments are offered to the Service Departments for official acceptance.

LOCATION

Off Chobham Lane at Chertsey, approximately 30 miles southwest of London.



Challenger Power Output Testing

CAPABILITIES

Topography: The topographical features of the 3 main test track complexes under the control of RARDE (Vehicles Department) are:

Longcross - All hard surface tracks and static test facilities.

Bagshot - Wheeled vehicle rough road, Alpine circuits and a cross country area.

Long Valley - Separate tracked and wheeled cross country circuits.

Ranges:

Longcross.

- Main Track. This is the main stone rolled asphalt circuit with a 3.22 km (2 mile) centerline measurement. It is 10.67 m (35 ft) wide with banking to represent 65 km/h (40 mile/h) at its eastern end, and 95 km/h (60 mile/h) at its western end. Incorporated into the circuit along its northern course, is a 400 m straight approximately 2.5 cm (1 inch) out of level.

- Rough Road Demonstration Course. A wheeled demonstration rough road, surfaced similar to the main rough road facility at Bagshot Test Track, and surfaced with natural flint ballast bound in its own hoggin, is provided for demonstration and short duration rough road vehicle trials. The loose nature of the surface, together with the effect of flying flintstones results in severe wear to the tires, brake lines and all other fittings found underneath a vehicle chassis. The stresses imposed on the vehicle chassis and suspension make this an "accelerated testing" course.

- Rain Test Facility. This facility consists of a hollow, framed tubular pipe construction with rainmaking water nozzles. It is designed to subject vehicles and equipment to controlled rainfall conditions in order to check for water ingress and its effect on the operation of the equipment under test. The water producing pipework is 30 m (98 ft) long and

vehicles may be either static or driven through the test facility.

- Tilt Platform. The platform can tilt vehicles to a maximum of 50°. There are overhang plates at either end and on the downward side which allow for large load overhangs to be accommodated, for example a loaded tank transporter.

• Bagshot Test Course Complex.

- The Main Course. This is a 3.7 mile rough road course suitable for wheeled vehicles of all sizes (including loaded tank transporters). Rough Road is a graded, compacted surface of flintstones (up to 6 inches in diameter) with a clay and sand binding. With use, the road becomes rutted and covered with potholes and this combination provides a very severe test for suspension systems and tires. The course is regularly maintained but dependant on weather, the surface condition may display marked differences.

- Alpine Course. This is a narrower, steeper (up to 1 in 2.7 gradient) 3.5 mile circuit constructed with the same mixture of flint, clay and sand. The last four up gradients are additionally surfaced with "Somerfield Trackway," a combination of wire netting and bars staked into the ground. The course is suitable for all-wheel drive vehicles.

- Cross Country Area. There is a central, approximately 1 km square, cross country driving area consisting of sand and mud between heather and small trees. This is suitable only for all wheeled drive vehicles.

• Long Valley Test Courses. The Long Valley test course complex is situated approximately 17 miles south-west of the main Establishment. It forms part of a large Army Department-owned Training Area (Aldershot Garrison Training Area B4). RARDE has three separate courses here:

- Cross Country Area for Tracked Vehicles. This is approximately 2 km square and is left in its natural state which consists of large potholes full of water with fairly extensive rutting. These are sometimes frozen hard in winter, very slippery during the spring and autumn and can be very dusty during the summer. The area is suitable only for heavy tracked vehicles. Included is a 4 mile high speed tracked vehicle circuit.

- Cross Country Course Wheeled Vehicles. This is approximately 4 miles long and consists of both sandy and gravel sections. In the main it is left in its natural state though the worst ruts are occasionally levelled. It is suitable for all-wheel drive and improved low mobility wheeled vehicles, together with light tracked AFVs.

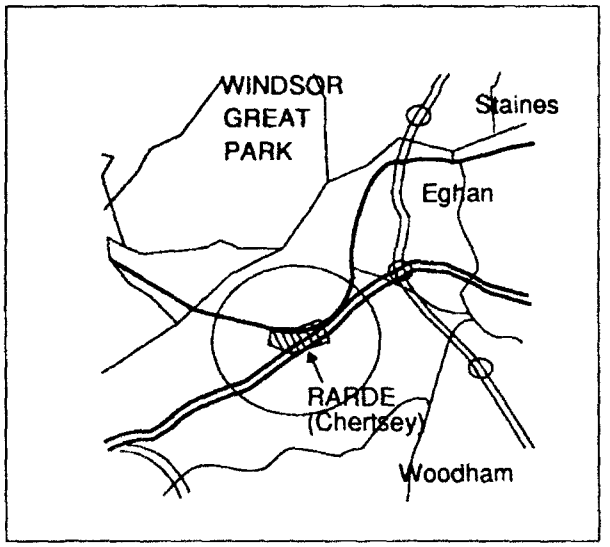
- Rough Road. A 4 mile long rough road graded wheeled course similar in construction to that found at the main rough road course complex at Bagshot This is soon to be extended to a more acceptable length incorporating several gradients.

- Rocky Terrain. This facility consists of a specially constructed, severe, closely undulating concrete course of approximately 300 ft (91.4 m) for heavy tracked vehicles. The facility is so positioned that either high or low speed runs may be undertaken over it. It is a very severe test of tracked suspension systems. The facility is sometimes referred to as the "Iranian river bed." It is positioned on the eastern side of the test course complex between the main AFB and outside the wheeled cross country area/circuit, adjacent to the southern end of the EELMOOR driver training circuit.

POINT OF CONTACT

Staff Officer Trials
RARDE, Chobham Lane
Chertsey, Surrey KT16 OEE

Telephone - Longcross Ascot 23366, ext. 2581
- Bagshot Chamberley 26262
- Long Valley Aldershot 21777



ROYAL ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (RARDE) CHRISTCHURCH

MISSION

Testing authority for military construction equipment. In addition to development for purely military needs, Christchurch carries out research in support of development and tests of commercial construction plant and equipment for industry. These tests are carried out on a repayment basis. Some facilities available to industry are discribed below.

LOCATION

Off the A-35 roadway west of Christchurch.

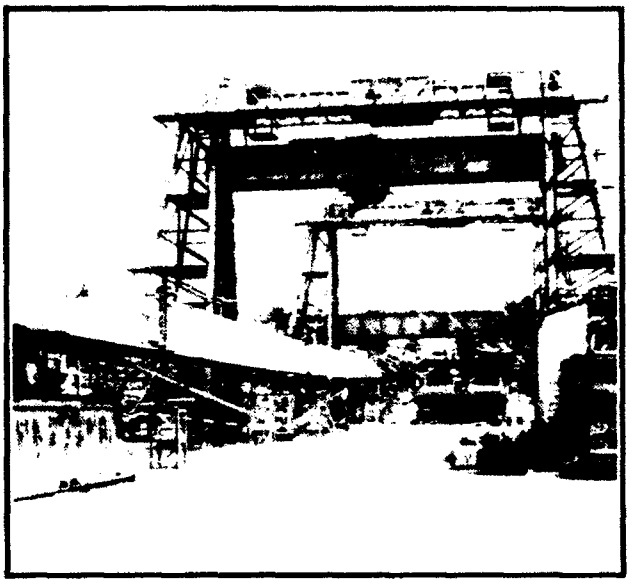
CAPABILITIES

Facilities:

Facilities within the Motor Vehicles and Engineering Establishment (MVEE), at Christchurch, include a well equipped laboratory block for materials research; bridging test rigs; and an electrical and mechanical test house of advanced design.

The facilities outside the Christchurch establishment, controlled by MVEE, includestwo areas of 392 and 303 acres located in sandy heathland at Barnsfield and Hurn, about seven miles from Christchurch. A third area of 50 acres with clay soils at Sandleheath, some two miles west of Fordingbridge. These areas, which include test tracks and test slopes, are used for the proving of construction equipment, mainly in the earth moving and road construction fields.

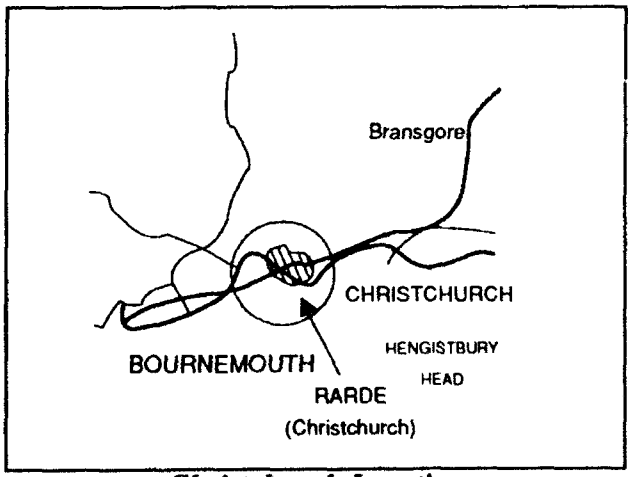
The Test Track facility has been the subject of continued improvement and the present system consists of six lanes, each designed to enable specific performance data to be evaluated for the various machines to be tested. The overall length of the center track is 2350 feet, the others are 1320 feet. At each end, turn-rounds exists. The entire track is level and enables designers to check correctly, by standard methods, the drawbar pull, the adequacy of tires, inflation pressures and running gear design of their projects. These lanes are invaluable for assessing the performance of the entire systems.



Bridge Testing Rig-Christchurch

POINT OF CONTACT

Staff Officer Trials
RARDE Christchurch
Dorset, England



Christchurch Location

U.K.

ROYAL ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (RARDE) KIRKCUDBRIGHT

MISSION

The range has been developed to carry out trials associated with the weapon systems and protection of Armored Fighting Vehicles (AFV) and has facilities for trials associated with the development of certain anti-armor projectiles. The range can also be used for trials with anti-armor guided weapons.

LOCATION

Kirkcudbright Range is situated in Galloway approximately 97km west of Carlisle , Scotland.

CAPABILITIES

Topography: Located on the coast between Kirkcudbright and Dundrennan, occupies just under 20 x $10^6 m^2$ of generally rolling land with some trees and low hills.

Ranges:

Gypsy Point

- Firing Point Facilities. Tanks using most types of ammunition can fire from either the beach or the plateau. On the beach the tanks can fire at ranges up to approximately 150m from the target and on the plateau at ranges up to approximately 200m.

- Suitable Uses. Attack of armor, protection and mine trials are typical uses. The maximum radius for a safety trace is 1200m.

Flash X-Ray Facility

Balmae Range.

- Firing Point Facilities. A concrete firing point which is large enough for one main battle tank (MBT). At the rear of the firing point is a bedplate 3.9m x 6.4m over which a rail mounted corrugated iron clad building can be placed to give visual and weather protection.

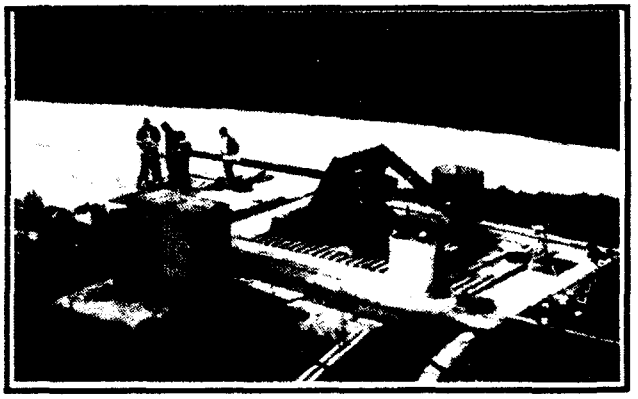
Cable rails and underground ducts carry cables for instrumentation and photography between the firing point and the control building.

Projectile velocity measuring equipment is permanently installed.

- Suitable Uses. The Firing Point is especially suitable for trials concerning gun subsystems. However it is also very adequate for accuracy, reliability or similar trials up to 780m.

Little Balmae Range.

- Suitable Uses. Currently used for developing LAW 80 this Firing Point could be used for any short range work from a vehicle. It is probably more suitable for manned firing than unmanned.



Firing Point Facilities

Howwell Range.

- Firing Point Facilities. There is a hard stand for a tank. Permanent facilities exist for projectile velocity measurement, windspeed and direction and CCTV. Underground ducts with loose covers to facilitate the laying of extra cables exist.

- Suitable Uses. Attack of armor, kinetic and static and any other short range trial.

Silver Hill.

- Firing Point Facilities. There is a permanent structure with installed photographic and instrumentation equipment. An Ammunition Conditioning Caravan is located to the rear of the site.

- Suitable Uses. Currently used by BAe exclusively but suitable for direct fire out to 2km.

Cairny Hill.

- Firing Point Facilities. A sloping concrete area leads to five small vehicle parking spaces with 5m separation between each.

- Suitable Uses. Observation only as any use involving a danger area would mean closing a public road.

Doon Hill.

- Firing Point Facilities. Concrete area for tanks and large equipments. A 3m x 4m bedplate is situated at the rear of the point. Ducting is provided for instrumentation cables back to the control building. Permanent facilities include public address, velocity measurement of projectiles, wind speed and direction and mounting brackets for microwave antennae which receive video signals from downrange. Electricity is available with stabilized power supplies for instrumentation and external power supplies for high speed cameras.

- Suitable Uses. Accuracy shooting. Specifically designed for long range depleted uranium (DU) firings. Is also suitable for fuel fire suppression. Good for appropriate demonstrations.

Balig Range.

- Firing Point Facilities. There is a large concrete area fitted with a 3m x 3m bedplate. Ducting is provided for instrumentation cables back to the control building. Electricity is available with stabilized sockets for instrumentation use and external points for high speed cameras. Permanent facilities include velocity measurement of projectiles and Doppler radar.

- Suitable Uses. Specifically designed for accuracy firings for the DU round. Could also be used for accuracy firings either of vehicle-borne systems or from a gun mounting.

Raeberry Range.

- Firing Point Facilities. Concrete area fitted with a 3m x 3m bedplate. Ducting is provided for instrumentation cables back to the control building. Electricity is available with stabilized sockets for instrumentation use and external points for high speed cameras. Permanent facilities include velocity measurement of projectiles and Doppler radar.

- Suitable Uses. Specifically designed for Strength of Design for the DU round, mine attacks, any other short range firing either kinetic or static.

Chapel Hill.

- Firing Point Facilities. A concrete firing point large enough for one tank. Temporary equipment for measuring projectile velocity can be installed if required. Electricity is available.

- Suitable Uses. MBT trials when other firing points not available. Armored Reconnaissance training practices.

Brown Hill.

- Firing Point Facilities. The eastern firing point consists of a large concrete area with room for three MBTs. One bay provides facilities for measuring projectile velocities.

Sight calibration ranges are available. The western firing point is equipped with a 3m x 8m bedplate and with two alternative concrete positions. Ducting is provided for instrumentation cables back to the control building. Permanent facilities include public address, velocity measurement of projectiles, wind speed and direction and mounting brackets for microwave antennae with receive video signals from downrange.

Laser Hut.

- Facilities include power points, a Chieftain sight stand and radio and telephone points.

- Suitable Uses. Trailing sights and range finders.

Figure of 8 Circuit.

- Firing Point Facilities. The 10m wide concrete road has a total length of 728m. It lies on the side of a hill offering a horizontal straight of 110m, uphill and downhill left and right hand curves and a climb or downhill straight of a 1:11 gradient. The horizontal straight offers in addition to smooth concrete, two stretches of undulating concrete to simulate cross country movement.

- Suitable Uses. Accuracy shooting. Designed for shooting on the move either at static targets or the moving target facility (MTF). It can also be used for static shooting at the MTF at approximately 1300 - 1450 meters.

Central Firing Point (CFP).

- Firing Point Facilities. A concrete firing point 60m x 20m with permanent ramps for 5° and 10° angles of tilt and two "bridge" ramps with 5°, 10° and 15° slopes. Wind speed and direction instrumentation is permanently installed and facilities are provided for projectile velocity measurement.

- Suitable Uses. Accuracy shooting. Adequate for appropriate demonstrations.

Moving Target Facility.

- An electrically driven computer controlled target trolley is available to carry targets for approximately 500m on either crosser or oblique tracks. A variety of constant speed profiles are available up to 28m/sec together with agile programs. Programs can be written to meet specific customer requirements.

- Normal targets are plane stylized silhouettes of selected armored vehicles on a 7m x 4m target area on the crosser and 4m x 4m on the oblique. Thermal aiming marks or complete thermal silhouettes can be produced on request.

Examples of Instrumentation Services available.

- Range and Accuracy Trials
  + Gunlaying instruments.
  + Projectile velocity measurements at the gun and target.
  + Initiating time and time to shot ejection.
  + CCTV and VTR, display and recording of target strikes.
  + Meteorological data at the firing point and down range.
  + Public address and communications.

- Proof of Mountings
  + Buffer pressure and temperature measurements.
  + Recoil velocity and distance measurements.
  + Strain gauging of components under test.
  + Projectile velocity measurements at the gun.
  + Shot start and shot ejection times.
  + Multi-channel analogue recording systems.

- Measurement of Shock and Vibration. A well proven 30 channel facility exists to measure ballistic shock using miniature piezoresistive accelerometers. Weapons from small arms to hollow charge and main armament can be deployed against armor varying from an individual rig to a completely fitted out AFV.

- Blast Measurement. Using piezoelectric transducers, overpressures generated by explosive attacks can be monitored around items from small structures to complete buildings.

- Further Examples of Capabilities
  + Calibration of transducers and instruments.
  + Measurement of toxicity inside AFVs.
  + Monitoring of hull movements of AFVs when firing.
  + Measurement of gun barrel vibration when firing.
  + Surveys of range distances.

Examples of Photographic Services available.

- Still photography, in color and black and white, of vehicles, targets and equipment. Synchro ballistic photography (SMEAR) of shot in flight.

- "Documentary" type film and video recording of all aspects of trials work. High and medium speed photography, and high-speed video of attacks on targets, including the movement of dummies and equipment in hulls under attack.

- Full on site processing facilities of Flash X-Ray photography of shot in flight. On site processing (16mm color reversal, VNF-1) is available for all normal and high speed cine films, giving same-day access to trials results.

- Closed Circuit Television (CCTV) or trials, and photography of instrument dials, etc., for record purposes.

- Video recording of any PAL composite video signal, color or black and white with associated audio information.

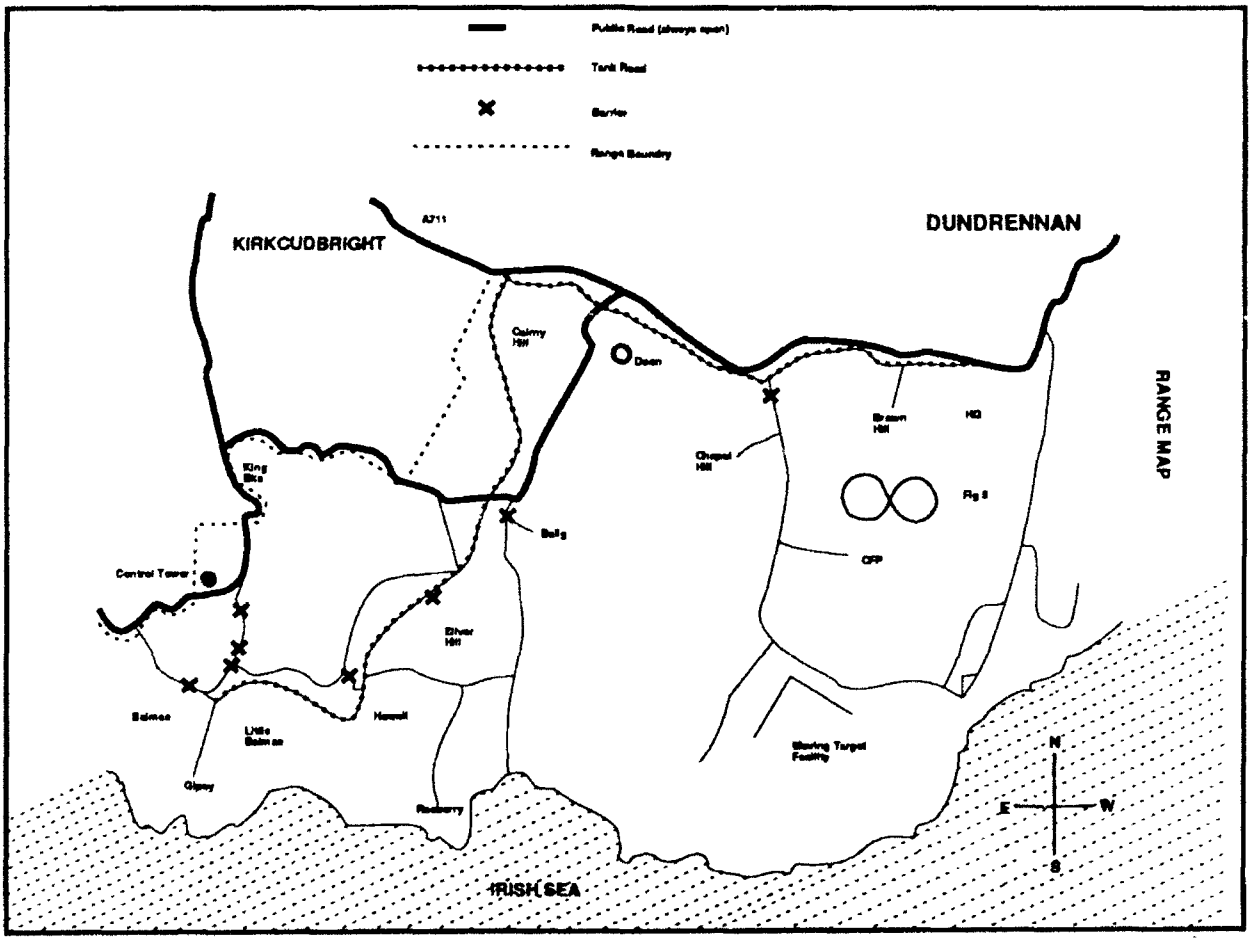
Targets. Screen targets with metal or plastic mesh and thermal targets can be made with 3 weeks' notice. Any rig should be completed and sent to arrive 1 week prior to the start of the trial.

Typical Projects Supported:

A wide variety of trials are undertaken by Armament Wing and these are mainly concerned with the operation of a tank as a gun system as opposed to gun development and proof firings. Research into armor protection, sighting systems and the mounting of guns in vehicle turrets is a secondary function of the Range. Spare capacity is utilized to accommodate trials originating from Royal Ordnance Plcs, Hunting Engineering and British Aerospace. Research into facilities, techniques and novel instrumentation systems runs concurrently with trials activities.

POINT OF CONTACT

RARDE, Girdstingwood, Kirkudbright
Scotland DG64QZ
Telephone:
Dundrennan (05575)271



Kirkcudbright Range

U.K.

DIRECTORATE OF PROOF AND EXPERIMENTAL ESTABLISHMENTS (DPEE)

MISSION

The Directorate of Proof and Experimental Establishments has the responsibility for testing conventional weapons for all three Services - during both development and production. Its facilities are also available to other organizations, including commercial companies.

LOCATION

The Directorate comprises a small Headquarters in London, Central Scientific Services based in Shoeburyness, Essex, six Proof and Experimental Establishments (P&EEs) and one Environmental Test Centre (ETC) situated in various parts of the UK.

CAPABILITIES

Under the control of the Director of Proof and Experimental Establishments (DPEE), seven establishments in the UK carry out a continuous program of trials and proof support of armament research and development and the subsequent acceptance into the Services of weapons and ammunition. These establishments vary widely in size and complexity, but each is capable of handling under controlled conditions, instrumented trials of the most modern and sophisticated weapons.

The P&EEs are fully equipped to carry out instrumented trials on all types of conventional weapon systems including guns, motors, mines, rockets, demolition stores and to proof a considerable range of munitions. In addition to these services, the expertise, resources and facilities available within these establishments enable them to offer a wide range of other services both to MoD and commercial customers. These services comprise Trials Definitions, Analysis and Management of Trials, Design, Engineering, Instrumentation, Quality and Reliability, Photographic Calibration, Hazardous Environment Test (Fire), Security/Riot/Terrorist Product Testing, Conference and Rental Facilities.

POINT OF CONTACT

Headquarters
Procurement Executive
Ministry of Defense
Directorate of Proof & Experimental Establishments
St. Christopher House
Southwark Street
London SE1 OTD

Telephone: 071-921 Extension
1450 (Trials Focus)
1324 (Registry)
2433 (FAX)
22241 (Telex)

CENTRAL SCIENTIFIC SERVICES (CSS)

MISSION

Central Scientific Services is situated at the P&EE Shoeburyness and provides a coordinated scientific service to all the DPEE ranges. This service includes instrumentation policy, research and development into new instrumentation techniques, methods and equipments and the coordination of the procurement of new instrumentation. It comprises three sections.

FUNCTION

CSS 1: Procurement and Support Services. Provide the technical coordination, control and progress authority for the procurement of instrumentation for the P&EE ranges. Provide project design and manufacturing facilities and computer aided design and drawing support to the other sections and P&EE ranges. Provide Health Physics, Health & Safety and Quality Assurance expertise as well as departmental administration, registry, technical library, control of student training, and career development and training.

CSS 2: Information Technology Systems. Provide expertise in computer systems, software and hardware. Responsible for the design, implementation and development of information technology systems and local area networks throughout the Directorate. Responsible for the design, development and quality control of software systems which may support specifically made instrumentation as well as providing organizational information systems.

CSS 3: Radar and Electronic Instrumentation Systems. Develop and install all major instrumentation systems for P&EE ranges. Particular expertise exists for radar systems, flash X-ray techniques, analog and digital acquisition systems and scientific computing. Design and implement proving and assessment trials in support of existing or new techniques and equipment.

POINT OF CONTACT

Telephone Numbers:

Superintendent	0702 292271, Ext. 3203
CSS 1	0702 292271, Ext 3205
CSS 2	0702 292271, Ext 3264
CSS 3	0702 292271, Ext. 3265

Address:

CSS/DPEE
New Ranges
Shoeburyness
Southend on Sea
Essex SS3 0SR

U.K.

P&EE COLD MEECE

MISSION

This Establishment undertakes production proof, in-service proof and trials and investigation for weapons and ammunition up to and including 30mm calibers for all three services.

LOCATION

The Establishment is located mid-way between Stafford and Stoke-on-Trent some eight miles from Junction 14 on the M6.

CAPABILITIES

Topography: The Establishment consists of 25 ranges, with tunnels and open ranges varying from 75mm to 1000m contained in 100 acres.

Tasks:

Group 1 is responsible for National proof and trials of all small arms ammunition, ranging from 0.22" to 30mm RARDEN.

Group II. As the European Regional Test Centre, proofs and trials weapons and ammunition of 9mm, 7.62mm and 5.56mm on behalf of NATO Panel III.

Group III is a small group more concerned with weapons than ammunition in that they proof guns on behalf of the Forces but they also carry out defect investigations and a number of special trials.

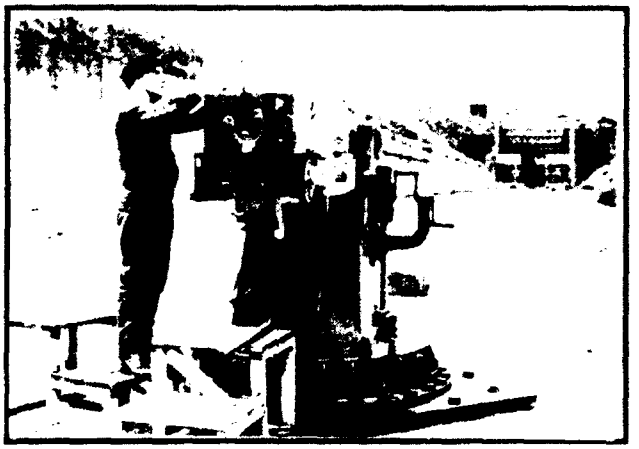
Engineering Group has a workshop where specialist equipment is made ranging from small precision items to large steel butts. This also includes the Armoury.

Instrumentation Group. The measurements of velocity, pressure and action time together with the computation and production of results is the responsibility of this group.

Facilities:

Velocity measured using sky screens, acoustic and magnetic methods.

Pressure measured by transducer up to 7000 bars and copper cylindrical crushers up to 25 ton/sq in.



Proof Testing Ammunition

Breakdown of ammunition and measurement of bullet pull and physical and chemical parameters.

Cork box recovery of inert rounds.

Salt spray.

MNT Lab Chemical test to accelerate aging of brass cartridge cases.

Waterproof and airtightness testing.

Conditioning of ammunition for firing between 115°C and -70°C. Limited climatic cycling including humidity.

Not provided on site: sophisticated photography, flash X-ray. Radar and telemetry are not available from local resources but can be provided through HQ DPEE.

POINT OF CONTACT

Proof & Experimental Establishment
Stone Staffordshire
ST 15 OQR
Superintendent
0785-760060 Ext 201
Deputy Superintendent
0785-760060 Ext 202
Secretary
0785-760060 Ext 253

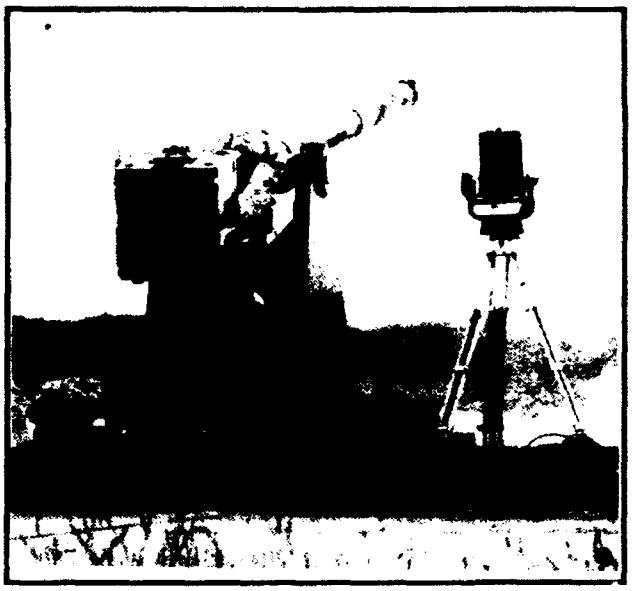
P&EE ESKMEALS

MISSION

The Eskmeals range is complementary to Shoeburyness and provides facilities for longer range ballistic and end of trajectory firings. Specialized facilities include radar tracking of shells and rockets out to a range of 35,000 meters, and plating butts for all kinetic energy (KE) projectiles.

LOCATION

P&EE Eskmeals lies on the Cumbrian Coast midway between Barrow and Whitehaven, within the Lake District National Park and due west of Lake Windermere. It is off the beaten track of the tourists and because of restrictions of development there had been little change over the years in the local surroundings except for the expansion of the British Nuclear Fuels Plant at Sellafield, seven miles NNW of the range.



120mm L11 Chieftain Tank Gun Fires Kinetic Energy Tracer Ammunition

CAPABILITIES

Topography: The range to seaward is situated between two air lanes which converge on the Isle of Man, 32 miles W of the range and these effectively provide the limits of the allocated air danger areas. Because there is no sea danger area except for the small Bye Laws area, the air danger areas delineate the firing limits, giving a normal maximum range of 30,000 yards and with NOTAM action 40,000 yds.

The sea, to the west of the range, is covered by radar out to 40,000 meters and although there is no regularly used sea lane in the area, there is an increasing number of fishermen and yachts which interrupt firings, especially in the summer months. The Bye Laws give the range some jurisdiction over a sea area of 5 km radius from the range and a range boat is used to move intruders out of this small area if they are infringing the Articles.

Access to the range is not good. By road it is at least an hour's journey from junction 36 on the M6, much of it along country roads. By rail it is possible to reach Bootle Station, 2 miles from the Range, from Preston or Lancaster via Barrow. However this entails a further 2 hours train journey once leaving the main line at Lancaster.

Ranges:

The range stretches for about 3 kms along the sandy coast and at its widest is about 1 km. It has a road and rail access linked with an internal road and rail system. There are 13 permanent Observation Posts spread out along the coast from which accurate cross-observation of Fall of Shot and Heights of Burst can be made. However these are only used infrequently. The range owns, and has firing rights over, land neighboring the range boundary.

Facilities:

There are 13 Batteries, spread throughout the Range area, most of which fire to sea. Because of safety distances only the North end of the Range fires HE. The South end is kept for inert firings. Generally speaking the Range can fire up to five Batteries in any one day. Most of the Batteries are specific to certain types of proof or trial. Safety distances overlap in a number of cases, putting neighboring Batteries under cover. The Batteries are not permanently manned but the staff move from Battery to Battery depending upon the firing program.

U.K.

Most Batteries have the necessary support buildings for observation, ammunition, including charge adjustment, heating chambers, maintenance and instrument rooms. There is an extensive and modernized magazine area with centrally controlled freezing vans. A few notes on each of the Batteries:

- Skelda. Main inert proof Battery situated close to sea with five bedplates, rail and all facilities.
- Towers. Unguided rocket site with camera locations and radar tracking back-up.
- M6. Range and Accuracy site with kinetheodolite facility and radar tracking back-up.
- Monk. Range and Accuracy Battery situated close to sea with five bedplates, rail and all facilities including radar tracking back-up. Back-up inert proof Battery.
- Shore. Includes Shore 1, 2 and 3:

+ Shore 1. Small caliber enclosed armor proof Battery.

+ Shore 2. Heavy caliber enclosed armor plating battery with 100m firing point and enclosed butt.

+ Shore 3. Heavy caliber armor plating battery with enclosed butt and 100m and 200m firing points and Flash X-ray.

Shore Battery has heavy plate lifting capability and all the normal Battery facilities.

- VJ. Heavy caliber armor plating Battery with 165m to 200m firing points, a semi-enclosed butt for depleted uranium shot and Flash X-ray. VJ Battery has all the normal Battery facilities but with tracked gun mountings only. It has an integral Health Physics Section.
- Overland. 1000 yds Vertical Accuracy Battery for tank ammunition.
- Dunes. This battery also has a Free Recoil facility. Forward of the bedplate there is an impact area 500m by 300m for trials such as fuze arming distances, smoke canister firing, etc.
- Sandy Gap. Main HE Proof Battery including a HESH butt, with three bedplates, rail and all facilities.
- Field. Secondary HE proof Battery with one bedplate, rail and limited facilities. Butt on the sea wall for special target trials.
- Esk. Butt recently completed and instrumentation available including Flash X-ray for special armor and plate trials.

+ Workshop Facilities. There are well equipped mechanical engineering and electronic workshops, which can modify and manufacture equipment for trials. Craft training is undertaken in an apprentices workshop, although tragically, this seems unlikely to continue after contractorization. In the Main Workshop are facilities for cutting armor plate up to 10in thick, machining capacity for structures up to 20 ft long and 20 tons in weight, also guillotine and folding facilities for metal sheet up to 1/2in thick. There is a shot blasting facility capable of accepting all but the largest mountings when stripped down for overhaul, and a range of machine tools including a CNC.

Radar Tracks the Trajectory of Rounds Fired

Instrumentation. An Instrumentation Group is equipped to meet the proof and trials requirements. Examples of the types of instrumentation include:

- Two shell and missile tracking radars which are digitized and coupled to a Perkin Elmer Computer. They are the only shell tracking radars in UK.
- Contraves kinetheodolites for tracking and for Jump measurement.
- Equipment for Radar Fuze Timing.
- Muzzle velocity measurement by photoelectric devices and by radio Doppler methods.
- Spin measurements by use of magnetized shells or photography.
- RM and AM listening and recording of fuze functioning.
- Heights of burst by using directors.
- Measurement of Fuze Delay Times on HESH shells.
- High and low speed photography in black and white and in color.
- Flash X-ray fixed and mobile facilities, providing pictures of shot passing through one or more armor plates of different thicknesses and angles of attack. Velocities of shot and fragments can be obtained from these pictures.
- Recording of attitude and spin rate of shells in flight by means of data telemetry signals from a yaw sonde fuze.
- CCTV for indirect viewing of trials, recording and replay facilities.
- Equipment for Blast, Pressure and Strain measurements.

POINT OF CONTACT

Procurement Executive
Ministry of Defense
Proof & Experimental Establishment
Eskmeals, Millom
Cumbria LA19 5YR
Telephone: Ravenglass(STD 065 77)
631 Extension 212 (Deputy Superintendent)

THE ENVIRONMENTAL TEST CENTER FOULNESS

MISSION

This center provides, under controlled conditions, service environments for testing explosive filled stores.

LOCATION

On Foulness Island, NW of Southend-on-Sea.

CAPABILITIES

Topography The Environmental Test Center (ETC) provides, under controlled conditions, service environments to test explosive-filled stores. (The ETC is an accredited Testing Laboratory). These tests are part of trials which can:

Test design against Staff requirements or similar performance specifications.

Technically assess or evalute equipment. These trials establish how safe and reliable equipment will be in service and how nearly it meets the Staff requirements.

Test Quality. These trials fall into four categories:

- Tests of early production to ensure production quality is of the standard accepted by the Approving Authority.

- Periodic tests during production.

- Tests arising from Service defects to establish the cause and that any modifications are effective.

- Tests to verify the effects of Concessions and Production Permits.

The stores that can be tested are determined by size (at present up to 7m length) and Net Explosive Content (at present up to 1000Kg).

Ranges:

Availability to Users. The ETC is available to any government department or government sponsored body and industry for the environmental testing of explosive-filled stores or other potentially hazardous items. Subject to the general work level and the nature of other work, priority can be given to urgent trials, investigations, etc. Tests on inert items can be undertaken if:

- They are a preliminary inert version of an explosive weapon which is likely to be tested at the ETC.

- The ETC is the only available site with the required facility.

- There is an overriding degree of priority.

Facilities:

The facilities available at the ETC are:

- Controlled conditions of temperature, pressure and humidity.
- Rain, mist and corrosion.
- Blown sand and dust.
- Sine and random vibration at various temperatures.
- Remote breakdown.
- Sectioning.
- Rough Usage caused by free-fall, crane swing stacking, toppling and rolling.
- Shock.

POINT OF CONTACT

Superintendent
0702-217272 Ext 600
Deputy Superintendent
0702-217272 Ext 602
Secretary
0702-217272 Ext 608

U.K.

P&EE INCHTERF

MISSION

This is a closed range which is specially equipped to handle proof of propellant and proof of ordnance. Trials work includes charge development for new weapon systems and investigation of internal ballistics problems. The main activities of the establishment are propellant, gun and plate proof and internal ballistics trials.

LOCATION

Twelve miles Northeast of Glasgow, adjacent to the A 803 between Kirkintilloch and Kilsyth.

CAPABILITIES

Topography: The site comprises a magazine, two batteries, a plate range and control and administrative areas with associated workshops and stores.

Ranges:

Battery Facilities. The batteries are designated as closed ranges which allows the horizontal firing of inert projectiles into stop butts from 150m. They are equipped to fire guns up to 165mm caliber. Both batteries are serviced by railway transport and gantry cranes. East Battery has seven gun positions and a facility for rail mounted ordnance. West Battery has eight gun positions and additional firing points for 81mm and 51mm mortars and a back-blast stop for recoilless weapons.

Plate Range. This range has a single firing point with associated stop butt and is currently fitted for .30in, .50in and 20mm weapons for use in the proof of armor plate. The firing distance is 55ft.

Facilities:

Facilities exist for charge preparation and adjustment, shotting-up and bullet pull up to 105mm calibre, and conditining for which there are six chambers: three set at 21°C, two which can heat to 82°C and one which cools to minus 53°C.

A high pressure transducer calibration facility is to be submitted for National Measurement and Accredition Service (NAMAS) certification.

Layout for a Trial on a 120mm Tank Gun

Trial on 81mm Mortar

The magazine administrative, processing and temperature controlled storage facilities have been recently redeveloped.

Resources:

The batteries and plate range are equipped with PCCs and MV and strike velocity measurement. Copper crusher and piezo-electric gauges are available for chamber pressure measurements. (Barrels can be drilled on-site).

POINT OF CONTACT

Procurement Executive
Ministry of Defense
Proof & Experimental Establishment
Inchterf
Milton of Campsie
Glasgow G65 8AQ
Telephone:

041 776-2313	Extension 224 (Superintendent)
041 776-2313	Extension 229 (Deputy Superintendent)
041 776-2313	Extension 229 (Secretary)

P&EE LAVINGTON

MISSION

This range is an outstation of Shoeburyness, where specialized vertical recovery firings are carried out.

LOCATION

On the Salisbury plain approximately 10 miles northwest of Salisbury.

CAPABILITIES

Topography P&EE Lavington, near Devizes, comes under the direct control of Superintendent P&EE Shoeburyness. The Range occupies 600 acres on the edge of the Larkhill danger area where the soil is chalky and relatively free of flint. This is important because the main function of the Range is to fire shells vertically for subsequent recovery from the chalk. When they reach their maximum height the shells come down base first, penetrate about 10 ft into the ground and are recovered by the use of an auger. This technique is particularly useful for fuze and shell component development work and is an alternative to the over water recovery technique used at Shoeburyness.

Ranges:

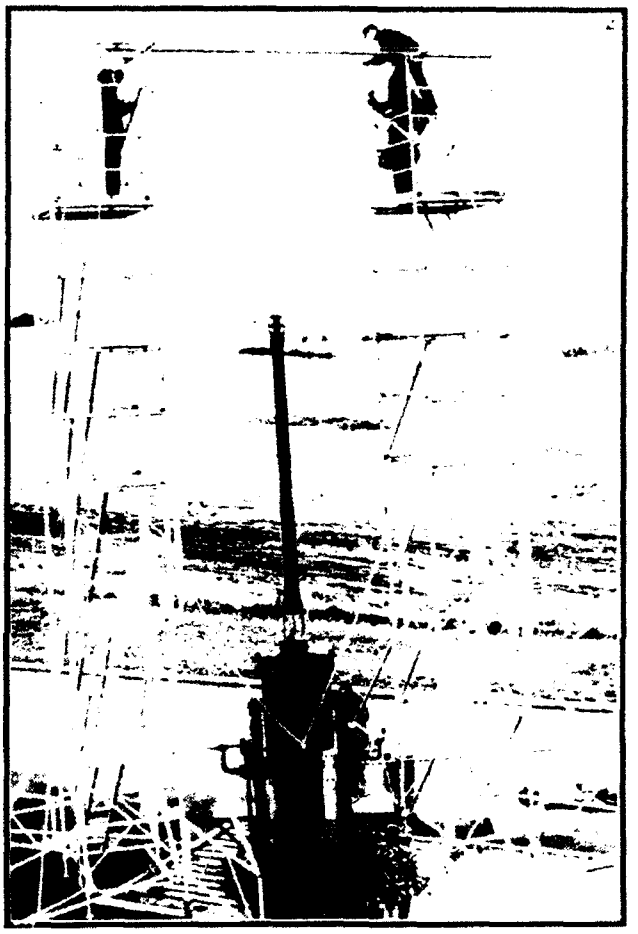
Main Firing Battery Compounds (2).

- Both batteries are capable of mounting a wide variety of gun equipments (15 bedplates) and mortars (in universal mortar mounting). Most guns/equipments are modified for vertical firing. Both batteries have ammunition storage and hot and cold conditioning chambers, (-47°C +63°C). Forward battery only: Amunition charge make up and determination facility and instrumentation room.

- Usage. Vertical recovery up to 63,000 ft altitude and conventional firing of guns and mortars. Explosive engineering. Static trials and drops.

Target Areas (all "Meadowland").

- Large impact area for most conventional projectiles including WP. No public access.



Preperation for Vertical Firing

- Dropping area gridded in 100 metre squares, triangular shape approx 2.1 km x 1.2km. This area used for:

+ Recovery of fired projectile (incl parachute recovery).

+ Measuring range and accuracy of short range projectiles.

+ Proof/trials of pyrotechnics.

+ Provision of field firing points as required, e.g., static detonations.

Listening OP with suitable aerials and listening/receiving equipment to cover transmitting components throughout flights when fired vertically.

Soft Catcher Butt capable of catching horizontally fired mortars and rockets which are required for recovery up to ranges of 400 metres.

Facilities:

Additional Miscellaneous Facilities

- Larkhill Met Station.
- Ammunition storage.
- Gun workshop.
- Plant including earth augers and crane.
- Horizontally fired mortar.

Remarks:

The Vertical Recovery Facility at Lavington is unique.

Lavington is particularly suitable for the following types of proof and trials:

- Smoke munitions.
- Mortars.
- Pyrotechnics.
- Gun components.
- Disposal of explosive waste.
- Fuze Testing.

Priority days for firing vertically are normally Mondays and Tuesdays.

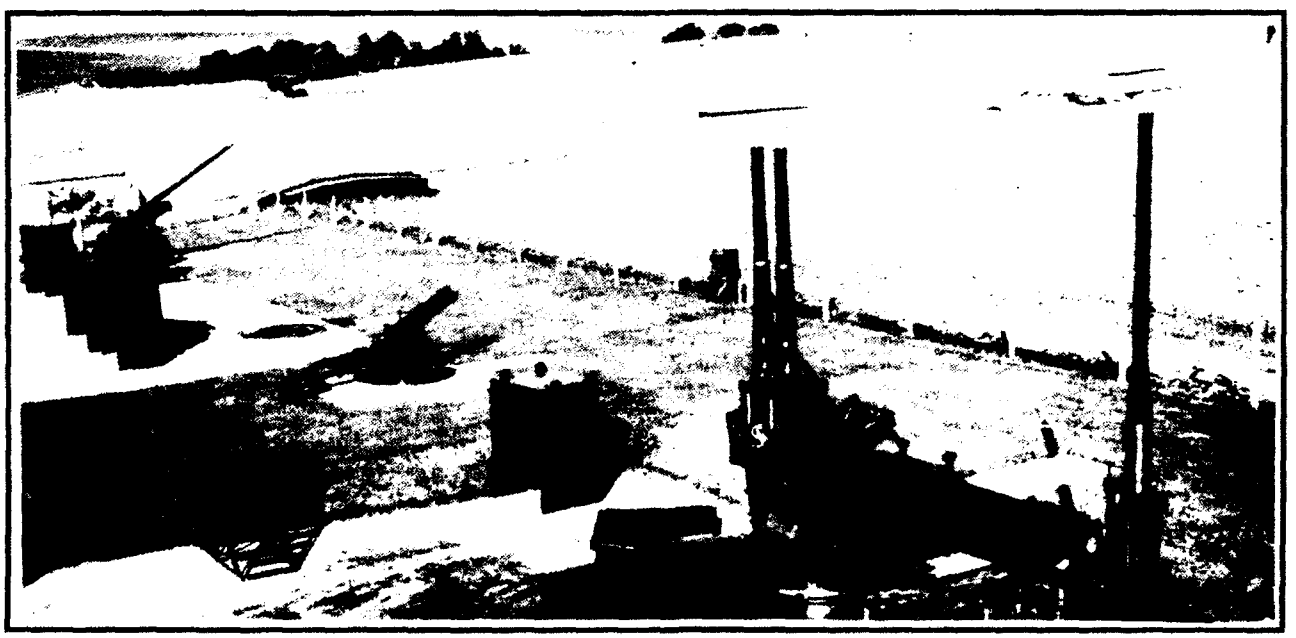
Resources:

Instrumentation. Most trials can be supported by:

- Chamber pressure measurement (crusher gauges).
- Velocity measurement (DR810).
- Fuze listening equipment as described in Facilities and Uses.
- Cross observation, soon to be independent of Shoeburyness, to produce range and accuracy and heights of burst in the impact area.
- Video coverage.
- Blast overpressure measurement.
- 'g' testing.

POINT OF CONTACT

Procurement Executive
Ministry of Defense
Proof & Experimental Establishment
Lavington, West Laington
Devizes, Wiltshire SN10 4NA
Telephone: Lavington (STD 038081) 3251 Extension 4 or 127 (Superintending Officer)



Vertical Firing Range

P&EE PENDINE

MISSION

The emphasis at this range is on small caliber weapons including the 81mm Mortar and RARDEN cannon. The facilities include 1500m long high speed test track for dynamic trials of weapon components, aircraft ejection seats, etc., and a climatic firing chamber and high altitude chamber.

LOCATION

Pendine is situated in West Wales about fifteen miles southwest of Carmarthen.

CAPABILITIES

Topography: The range occupies some 2500 acres of shoreland, mainly sand dunes and water meadow. There is an excellent network of roads within the range and a further 2500 acres of beach when the tide is out. There is an extensive sea danger area which is patrolled by a dedicated range safety boat.

Ranges:

There are twenty fixed firing ranges and the beach can be used as a firing point when the tide permits. The following trials are regularly fired.

- 81mm Mortar Proof and Trials (Barrels and Ammunition).
- 51mm Mortar Proof and Trials (Barrels and Ammunition).
- 20mm Proof and Trials.
- 30mm Proof and Trials.
- 40mm Proof and Trials.
- Ammunition Development Trials up to 40mm.
- Various Range and Accuracy Trials.
- Rapier Proof and Trials.
- Swingfire Proof and Trials.
- Law Proofs and Fuze Development.
- High Speed Missile Development.
- Airfield Cratering Device Development.
- Chaff Dispenser Trials.
- Drop Trials
- Attack of Armour and Aircraft Development Trials.
- Fuel Fire Trials.

Cold Weather Machine Gun Test

Armored Vehicle in the Dunes Near Pendine

- Bullet Attack Trials.
- Small Arms Trials of all types.
- Grenade Trials.

• A number of special facilities exist which are peculiar to Pendine.

Facilities:

Long Test Track (LTT) is 1500m long and consists of two parallel continuous lengths of railway line. The track is fully instrumented and trials can be comprehensively monitored by complex photographic and telemetry data systems. Caters for a wide variety of trials, including:

- Terminal ballistics against all types of targets.
- Aircraft escape systems.
- Rain/erosion characteristics of materials.
- Deployment of pilotless drone recovery parachutes.
- Wire dispensing systems for guided missiles.
- Testing components and assemblies under high acceleration loads.

Velocities of Mach 3 and accelerations of 130g are attainable.

Short Test Track (STT). Approximately 180 metres long. Test object can be propelled along the track by rocket motors: all up weights and velocities vary from about 45 kg at 500 m/s to about 250kg at 250m/s. The STT is used mainly for trials of anti-armour weapons. Typical uses of the track include development trials and production proof of guided weapon warheads, nose cones and safety and arming units, and simulated mid-air collision between system components. The track is fully instrumented.

High Altitude Chamber (HAC). Capable of pressures representative of altitudes to 30,000m (100,000ft).

Climatic Chamber (CC2 Range). Environment may be varied from +82°C to -55°C to meet the environmental specification required. Weapon systems, together with their associated ammunition, may be conditioned in the chamber and then fired through special ports over a dedicated range area.

- Weapons up to 40mm and mortars up to 81mm can be fired from the chamber. Quadrant elevations between +80° and -40° can be accommodated with depression firings contained in an enclosed sand butt. Over-land accuracy may be conducted up to a range of 100m whilst firings out to sea up to 18km can be accomodated. Firings of high explosive projectiles are limited because of the proximity of the range to occupied buildings.

Fuel Tank Trials (E6). The range is primarily used to simulate the raising of fires in fuel tanks and hydraulic pipes caused by strikes from typical warhead fragments, bullets and small calibers HE, AP, and T&I shells.

- To make the target truly representative an overtarget wind of 200-250kts and an in target air-flow of 25m/s is available. Hydraulic pressures of 2,000 psi and fuel line pressures of 20 psi may be fed through the target as necessary. Spark gear to simulate electrical shorts within the target is possible together with pulses to start/stop any inbuilt fire extinguisher system.

Impact Testing Facility (C8). This new range consists of a 450m track finishing with a solid concrete butt. Very large stores (currently 11 tons) can be impacted into the butt at speeds up to 125m/sec and the damage assessed.

Airfield Damage. There is a special range dedicated to assessing the damage caused to airfield runways by munitions. Concrete pads have been constructed to the same standards as used for runway construction.

Environmental Test Centre (ETC). In conjunction with BAe, the MOD operates two ETC facilities which can condition explosive stores of up to 120kgs (HD1.1) from -50°C to +100°C and vibrate them within this temperature range up to 400Hz with a maximum thrust of 80 kN.

• Sea Trials. A large sea danger area with patrol boat, chaff dispensers and decoy deployment. It is possible to obtain the services of larger boat platforms for sea trials of equipments.

Drop Tower. A new Drop Tower of 30m is capable of dropping explosive stores up to an all up weight of 500kg from any height up to 30m.

Support Services include:
- Explosive magazines and laboratories.
- Heavy engineering facilities.
- Design and construction workshops.
- Armory.
- Full instrumentation service.
- Data acquisition and processing facilities.
- Photographic coverage from stills to HS cine up to 40,000fps.
- Explosives conditioning.

POINT OF CONTACT

Proof and Experimental Establishment
Pendine
Carmarther
Dyfed
SA 33 4UA

Superintendent	09945-243 Ext 201
Deputy Superintendent	09945-243 Ext 202
Operations & Planning	09945-243 Ext 204
Secretary	09945-243 Ext 206

Adjusting a Mortar Between Firings

P&EE SHOEBURYNESS

MISSION

Conduct trials of all types of ammunition to ensure that new types meet performance requirements and are safe to fire.

LOCATION

East of Southend-on-Sea at the mouth of the Thames.

CAPABILITIES

Topography The New Ranges consist of part of the Essex Inland and Havengore, New England and Foulness Islands - a total land area of about 7,500 acres - together with some 30,000 acres of sands at low tide. They include a sea danger area, access to which is restricted by Bye Laws. Two other Ministry of Defence Establishments, AWRE, unconnected with the P&EE, and the ETC are situated on Foulness Island. Well over 5,000 acres of the Establishment are let for agricultural purposes and about 300 people live on the island in the two villages of Churchend and Courtsend. Foulness Island is surrounded by 19 miles of 21 ft high sea wall and the Establishment is responsible for taking appropriate action in respect of flood warning.

Ranges:

Most firings on the Range are carried out from established 'battery' positions equipped with the necessary buildings and specialized technical facilities although the sands are also used for some firings and areas between batteries can be used as required. About 19 batteries are in current use but safety and other considerations restrict the number usable at any one time. Some of the specialist facilities available for trials within the Establishment are:

- The ability to fire inert and HE filled shells fitted with a "plug representing fuze" into the sea and recover them for examination when the tide is out.

- Ranges at which tank guns can be fired for accuracy up to 3,500 meters.

- Surveyed lines on the sands which are 'pegged' every 100 meters and which enable the positions at which fired shells land to be very accurately determined. This information can be used for the compilation of Range and Accuracy tables for the Services. Ranges of up to about 18,000 meters can be determined using these pegged lines.

Fired Shells Retrieved From Sea Bed

- A battery site near the sea wall from which shells can be fired so that the entire trajectory of up to several thousand yards is over water. This is of value for the testing of certain naval fuzes.

- Large areas of suitable and relatively isolated land on which a wide variety of explosive trials can be safely carried out.

- Areas of flat and previously unused land in which mines can be laid and left under trial for long periods.

- An area with large concrete hardstandings, suitable drainage and instrumentation and other facilities where complete aircraft or airframe components can be fired at using weapons or explosive charges. There is also an aircraft engine test bed on which engines can be run under remote control.

- A sand target area where heights of burst of proximity fuzes can be measured at trajectory end.

- A site where Ranger mines can be tested.

- A facility on the sands for river mine work using the

incoming tide.

- A site where guns can be raised to fire in depression.

- An enclosed sub-caliber range.

Facilities

A number of mobile and static chambers, in which ammunition can be conditioned before firing to any temperature between -40° and +80°C, are available.

A range at which a target can be suspended between tall towers for the testing of VT (radio proximity) fuzes.

Replicas of the special magazines used for storage of ammunition and missiles on board HM Ships which are used for trials concerned with the safety arrangements for such storage.

A Standard Liquid Fuel Fire facility in which ammunition is suspended over burning kerosene so that its behavior when heated can be assessed.

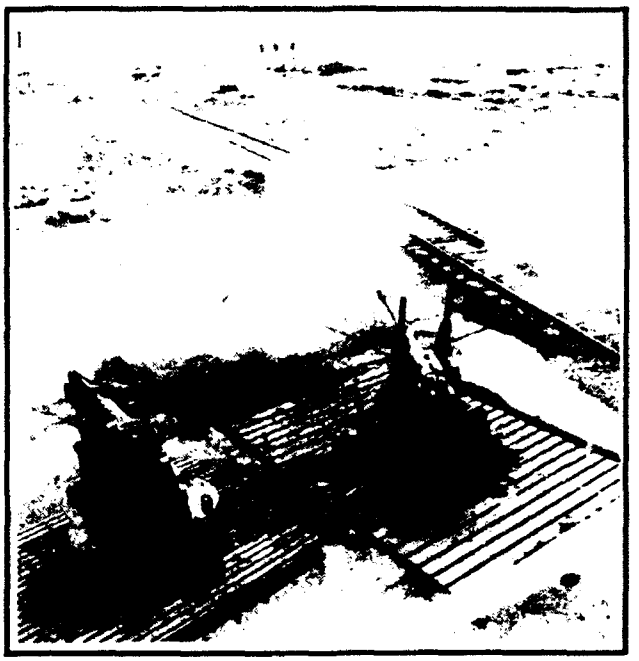
To support its trials and proof commitments, the Establishment has a large engineering workshop, ammunition storage magazines and laboratories, an instrumentation group and administrative support facilities. It has its own railway and meteorological station which provides not only met data for trials, but also acoustic forecasts so that large detonations can be timed to minimize nuisance to the public.

Resources:

Instrumentation of trials and proof is an important aspect of the work of the Establishment. DPEE has a Central Scientific Services organization which is located at Shoeburyness and is responsible for development of new instrumentation facilities and techniques for all P&EEs. P&EE Shoeburyness has its own large instrumentation group which provides instrumentation equipment, associated computation and computer facilities for analysis of results and suitably trained staff. A wide range of specialized equipment, including high speed cameras is used and some of the measurements recorded include projectile velocities, fuze delay times, blast pressures, projectile spin rates and gun chamber pressures.

TYPICAL PROJECTS SUPPORTED

Most of the trials work is carried out on behalf of the Royal Armament Research and Development Establishment, the Ordnance Board, the Royal Aircraft Establishment and other Establishments responsible for weapon or ammunition development. In addition, trials have also been conducted for various public authorities and private firms such as the Gas Council and Shell. Projects include:



Trials Against Steel Plate to Test Fuze

Strength of Design of New Gun Ammunition.
Development of New Equipment.
Effects of Blast and Fragmentation Warheads.
Antitank Mines.
Aircraft Engine Running Tests.
Liquid Fuel Fire Trials.
VT Fuzes.
Laser Work.
Explosive Ordnance Disposal (EOD).

POINT OF CONTACT

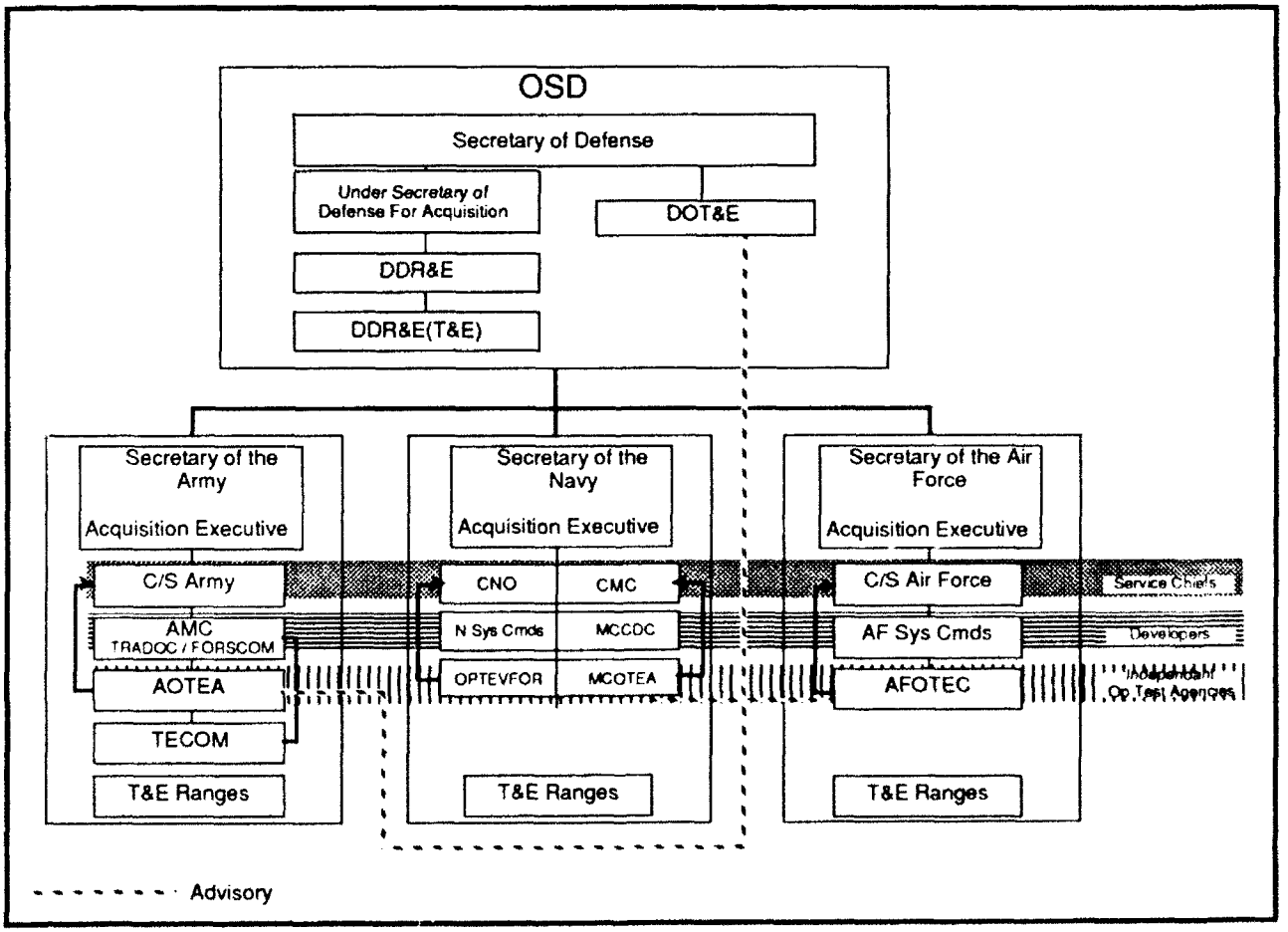
Central Scientific Services
(Superintendent of Instrumentation) c/o Proof & Experimental Establishment, New Ranges, Shoeburyness, Southend-on-Sea, Essex SS3 9SR

Telephone: 0702 292271,
Ext 3200 (Superintendent)
Ext 3202 (Dep Supt Ops)
Ext 3204 (Dep Supt Instrumentation)
Ext 3207 (Secretary)
Ext 3220/3427 (Marketing Officer)

UNITED STATES

UNITED STATES

The Secretary of Defense (SECDEF) exercises responsibility for acquisition of all military systems through the Under Secretary of Defense for Acquisition (USD(A)). Reporting to him is the Director Defense Research and Engineering (DDR&E) and his Deputy for Test and Evaluation (DDR&E(T&E)). The Director of Operational Test and Evaluation (DOT&E) is responsible directly to SECDEF and to the Congress of the United States for independent operational testing of weapon systems. The Secretaries of the Army, Navy and Air Force provide mission requirement information to the Office of the Secretary of Defense (OSD). Upon approval of development each Service is responsible for research, development and development, testing of systems. Upon certification of readiness, mature systems are then tested by independent Service test agencies in liaison with DOT&E. Within each Service, the Acquisition Executive is responsible for overall coordination of development, with Service Program Managers reporting directly.



U.S. Systems Acquisition Organization

The major military and test facilities of the United States constitute a national asset--sized, operated, and maintained under uniform policies for DoD test and evaluation support missions. Because of the unique capabilities and expertise of these activities, they also may be used in support of other U.S. government agencies, allied foreign governments, and private organizations. Test facilities include:

ARMY

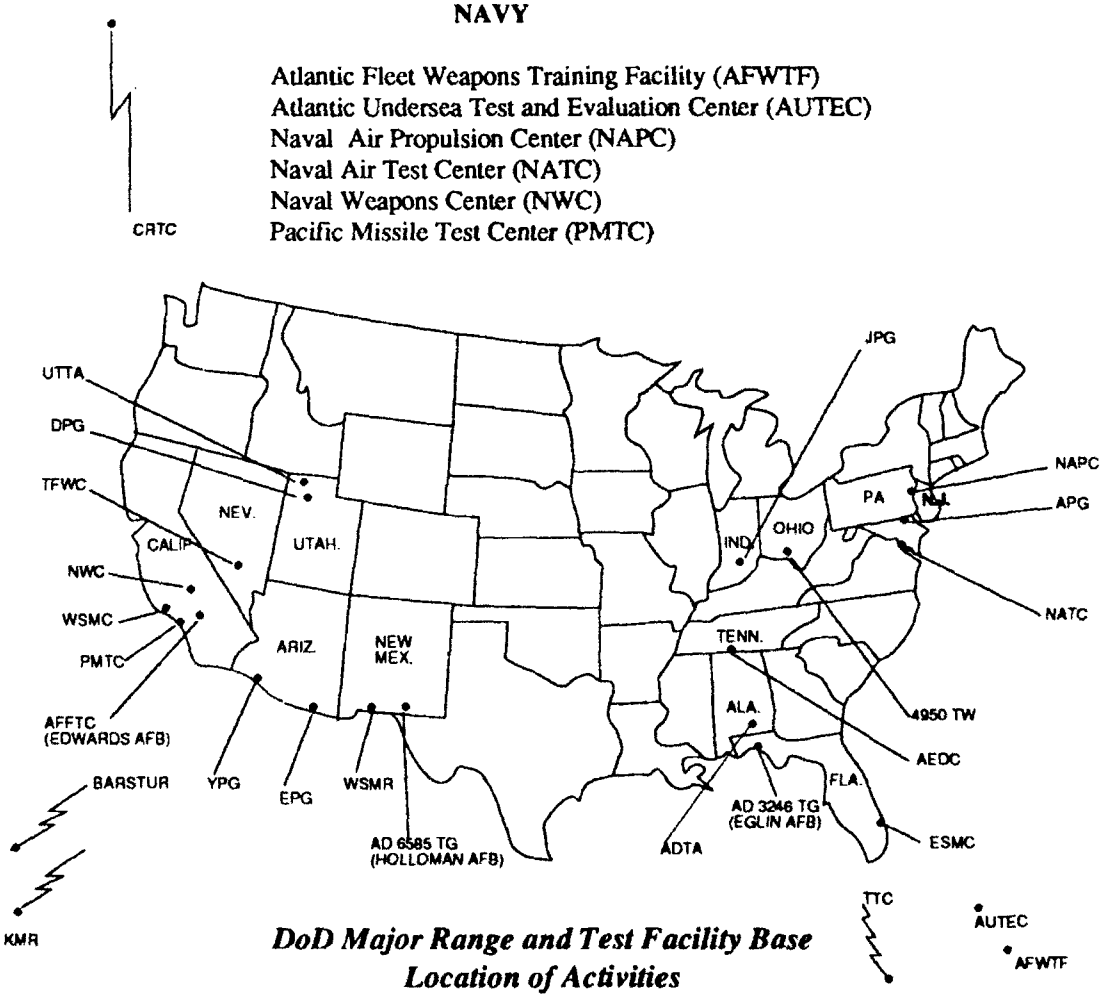
Aberdeen Proving Ground (APG)
Aviation Development Test Activity (ADTA)
Cold Regions Test Center (CRTC)
Dugway Proving Ground (DPG)
Electronic Proving Ground (EPG)
Jefferson Proving Ground (JPG)
Kwajalein Missile Range (KMR)
Tropic Test Center (TTC)
White Sands Missile Range (WSMR)
Yuma Proving Ground (YPG)

AIR FORCE

Aeronautical Systems Division 4950th Test Wing (4950th TW)
Armament Division-3246th Test Group (3246th TG)
Armament Division-6585th Test Group (6585th TG)
Arnold Engineering Development Center(AEDC)
Air Force Flight Test Center (AFFTC)
Eastern Space and Missile Center (ESMC)
Tactical Fighter Weapons Center (TFWC)
Utah Test and Training Range (UTTR)
Western Space and Missile Center (WSMC)

NAVY

Atlantic Fleet Weapons Training Facility (AFWTF)
Atlantic Undersea Test and Evaluation Center (AUTEC)
Naval Air Propulsion Center (NAPC)
Naval Air Test Center (NATC)
Naval Weapons Center (NWC)
Pacific Missile Test Center (PMTC)



DoD Major Range and Test Facility Base
Location of Activities

ABERDEEN PROVING GROUND (APG)

MISSION

Plan and conduct developmental and other tests on artillery weapons systems, ammunition, mortars, recoilless rifles, armored vehicles, armored trucks, materiels-handling equipment, engineering equipment, air conditioners, generators, mines, grenades, pyrotechnics, infantry weapons, small arms ammunition, hospital equipment, bridges, gun air defense systems, fire control equipment, optical equipment, night vision devices, mine detectors, mine-clearing systems, containers, clothing, rations, and Army marine equipment.

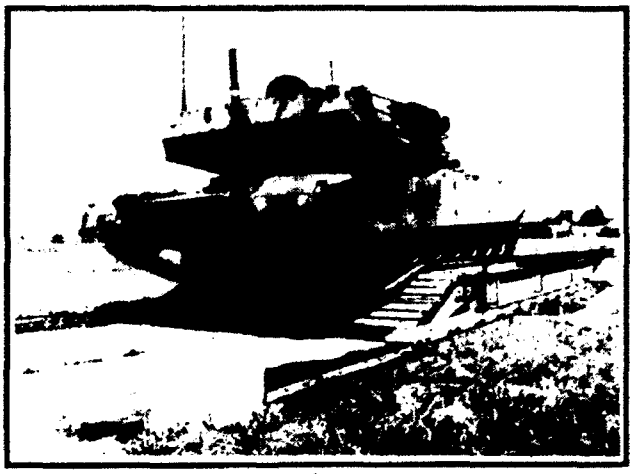
LOCATION

The Aberdeen Proving Ground (APG) is located on the western shore of the Chesapeake Bay, 30 miles northeast of Baltimore, Maryland.

CAPABILITIES

Topography : Sixty-eight thousand acres of generally rolling land and water are utilized for firing and explosive tests; communications and electircal power accommodate all types of weapons and ammunition tests from small arms up to and including 175 mm guns with maximum ranges of 25 km within reservation and 34 km within restricted air space (with land impact and recovery up to 22.5 km). Included are areas and facility groupings devoted to fragmentation and demolition testing, armor testing, rocket sled testing, vibration testing, and artillery and tank weapon testing. Three thousand acres are devoted to testing automotive equipment. Each test area is provided with test courses, obstacles, slopes, and ramps to permit the full gamut of performance and endurance evaluation on automotive and related equipment. Also, there are maintenance and service facilities to support work being conducted in the area. Another area incorporates a firing range and moving target for evaluation of tank weapons. A water course, equipped with ramps and docks, is used for amphibious vehicles and watercraft.

Logistics-over-the-shore marine transportation and ocean-exposed tests are conducted off-post. Variation in weather, terrain and vegetation at this single location provided the capability to conduct a major portion of the Army's spectrum of test and evaluation. An airfield with runways 5,000 and 8,000 feet in length, is located on the installation.



Tank Balance Test

Climatic Features: Average number of days per year of precipitation (.01 inches or more), 113; average annual snowfall, 13 inches; average annual rainfall, 39 inches. Average high temp, 88 F; average low temp, 23 F. Wind velocity, 4-12 mph, 63% of the time. Mean humidity, 70%.

Terrain features: Variation, including farmland (sand, clay, loam), woods, marsh, and open meadow. Relatively flat terrain varies from sea level to elevation of 60 feet.

Ranges :

Main Front Area. Approximately 28 firing positions, including five barricades and three cold rooms with capability for firing weapons of all calibers, out to approximately 22,000 meters. A full complement of instrumentation is available.

Mulberry Point and Plate Range. Approximately 26 firing positions for testing 40-millimeter to 175-millimeter ammunition. Includes firing over water out to approximately 20,000 meters.

Michaelsville Range. Approximately 26 firing positions for testing small arms up to 40 millimeters.

Armor Test Ranges. Eighteen ranges that permit shooting at armor plate and armored vehicles with all types of

weapons. Includes facilities that will contain the dust from depleted uranium projectiles.

Static Detonation Areas. Fifteen positions that permit evaluation of warheads, mines and demolitions, including blast and fragmentation.

Tank Gunnery Range. Real-time video monitoring and scoring.

Underwater Test Range. A medium scale underwater/water surface test site for evaluating explosive effects on partially or fully submerged structures of 7 tons or less.

Facilities :

Automotive Tests. Ten major test areas representing 39 miles of test courses devoted to automotive-type equipment. These test courses, which serve as baseline test courses for other installations, include the following:

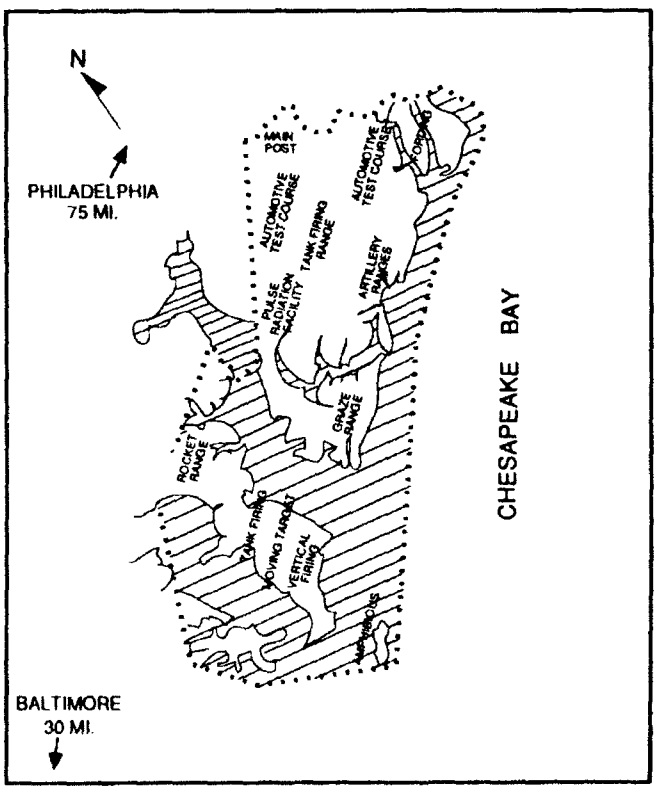
- Munson Test Course. Gravel roads and specialized courses, including Belgian block course, frame twister, side slopes of 30 percent to 40 percent, longitudinal slopes of 5 percent to 60 percent, staggered bump course, vertical walls, bridging devices, sine wave course, turning circle, and ditch crossing.

- Perryman Test Course. Eight cross-country courses of various degrees of severity used primarily for endurance reliability testing of vehicles.

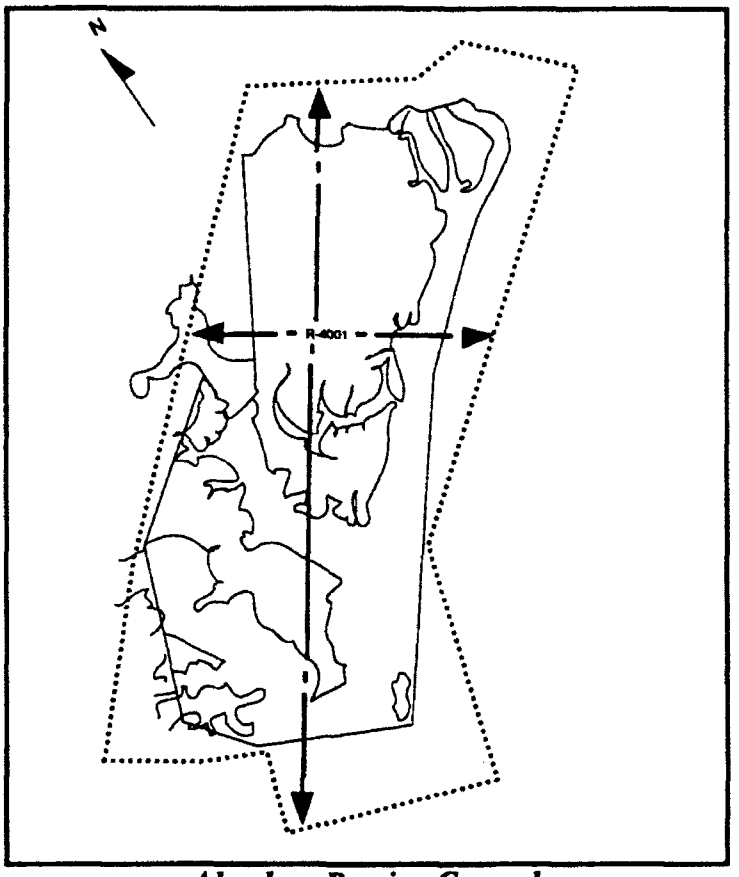
- Churchville Test Area. A series of steep hills with slopes up to 60 percent and winding terrains of gravel and mud.

- Other Test Facilities. Include sand mobility course, swimming area, deep water fording area, abrasive mud course, braking test courses, marsh, amphibious ramp, and high-speed road.

Environmental Tests. Facilities are available for conducting tests such as vibration tests of live ammunition and warheads at high and low temperatures, fungus tests, salt fog tests, humidity tests, solar radiation tests, bounce tests, electromagnetic interference tests (to handle complete weapon systems), rain tests, high and low temperature tests, noise and blast tests, and toxic gas tests.



Aberdeen Proving Ground



Aberdeen Proving Ground

Special Tests.

Army Pulse Radiation Facility. Provides a radiative environment simulating a portion of the nuclear weapon environment to determine the nuclear vulnerability of Army equipment and systems to satisfy DoD nuclear survivability requirements.

Flash X-Ray. 150-kilovolt to 2.3-megavolt output for radiographs of dynamic objects or events inside gun tubes, in free-flight, or entering, striking, or leaving targets. This is the largest facility of this type within the Test and Evaluation Command.

Live Fire Evasive Target System. Provides simulation of moving targets by projection techniques with automatic video scoring system.

Human Factors Laboratory.

Computing. Central computing and networking capabilities include HP3000 and IBM4341 (DPIT-701).

Resources :

Instrumentation

Fixed Velocity Towers
Recording Borescope
Fast Pulse Reactor
X-Ray Spectrometer
Waveform Analyzers
Universal Tension/Compression Testing
Data Recorders
Automated Viscometer
Flash X-Ray Units
Chromotography System

Dynamic Balance
Scanning Electron Microscope
Pressure Generators
Digital Shock and Vibration Controller
Coordinate Measuring Equipment
Electrodynamic Vibrator
Imaging Radiometer
Spectrum Analyzers
Magnetic Particle Inspection
RF Test Set

Targets. Hard and soft live fire targets, automotive and ground structures.

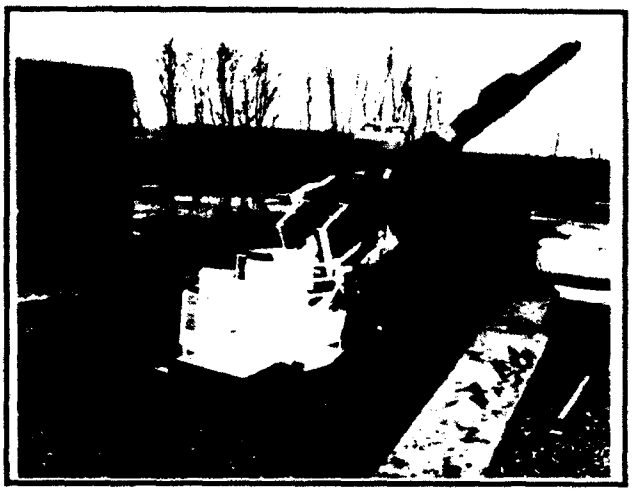
TYPICAL PROJECTS SUPPORTED

Artillery of all Calibers
High Mobility Multipurpose Wheeled Vehicle (HMMWV)
Improved Light Antitank/Assault Weapons
Bradley Fighting Vehicles System
Heavy Expanded Mobility Tactical Truck (HEMITT)
Abrams Tank (M-1)

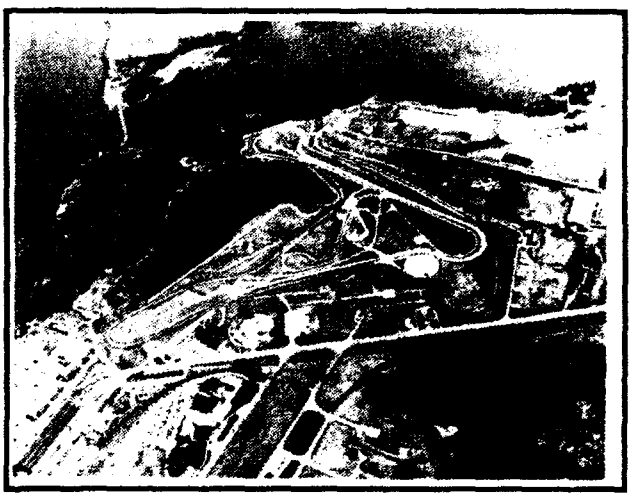
POINT OF CONTACT

Commander
U. S. Army Aberdeen Proving Ground
ATTN: STEAP-MT-M
Aberdeen Proving Ground, MD 21005

Telephone:
AUTOVON: 283-4639
Commercial: (301) 278-4639

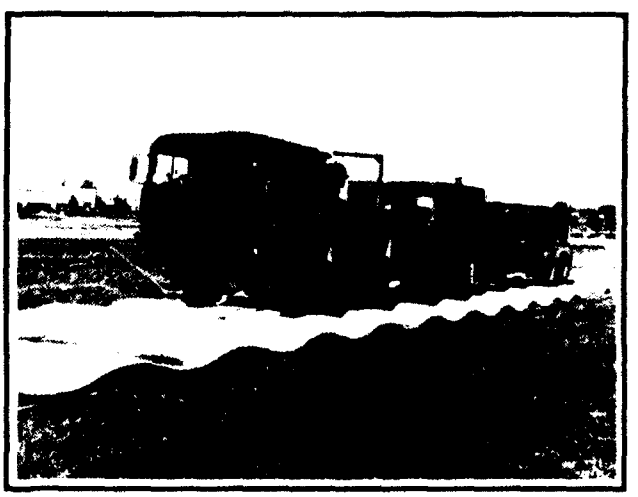


Recoil test



Munson test track

Live fire testing



Rough terrain test track

AVIATION DEVELOPMENT TEST ACTIVITY (ADTA)

MISSION

Plan, conduct, analyze, and report on development and customer tests of aircraft and aircraft systems and components to include foreign aircraft assessment, aviation life support systems, NBC aviation equipment, flight simulator systems, armament/avionics/countermeasures systems relative to aircraft interface compatibility/human factors/safety/logistics supportability/reliability, and the spectrum of aviation ground support equipment.

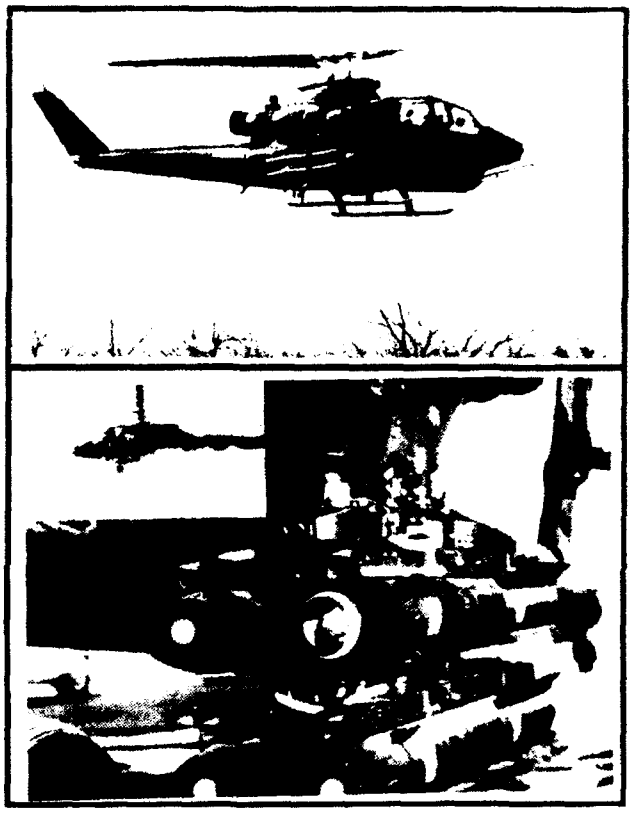
LOCATION

Cairns Army Airfield, Fort Rucker, Alabama.

CAPABILITIES

Topography :

Terrain: Generally rolling terrain, elevation 300-400 ft MSL. Consists of farmland, woods, swamps, and lakes. (Apalachicola Test Site, Florida: coastal land consisting of forests, beach areas, swamps, and open water of the Gulf of Mexico.)



ADTA R&D Projects

Climatic Features: Average number of days per year of precipitation (.01 inch or more) - 111 days. Average annual rainfall, 53 inches; maximum temperature, 101° F; average maximum, 76° F; minimum temperature, 7° F; average minimum, 56° F; wind velocity, 6 knots; average humidity 0400 hours, 87%, 1300 hours, 54%.

Facilities :

Assets include 15-25 testbed aircraft which are standard Army aircraft used to install and test related equipment, components, systems, fuels, and lubricants. Support and maintenance facilities are available to perform unit, intermediate, and limited depot maintenance or modification on Army aircraft and related equipment. The activity operates a modular engine test system capable of test running any current Army turbo engine. A tactical test site at Apalachicola provides semitropical environmental conditions representative of those found in many areas of the world for operation of test equipment under field conditions.

The Class C photo lab operated by the activity provides both test data collection and documentation work in support of projects. Data reduction is available using an IBM 4361 computer (DPI-T703), which is connected to the IBM 4341 computer at Aberdeen Proving Ground. Oil analysis laboratory support is provided by Fort Rucker. An overland range at Fort Rucker and an overwater range at Apalachicola, Florida, are available for armament firing. Air Force ranges and the climatic hangar at Eglin Air Force Base are within the local flying area.

U.S.A.

US ARMY COLD REGIONS TEST CENTER (CRTC)

MISSION

Conduct cold regions environmental testing on a variety of military equipment and systems, including weapons, vehicles, general, and personnel equipment.

LOCATION

East Greely, Alaska, located 105 miles southeast of Fairbanks and 335 miles northeast of Anchorage.

CAPABILITIES

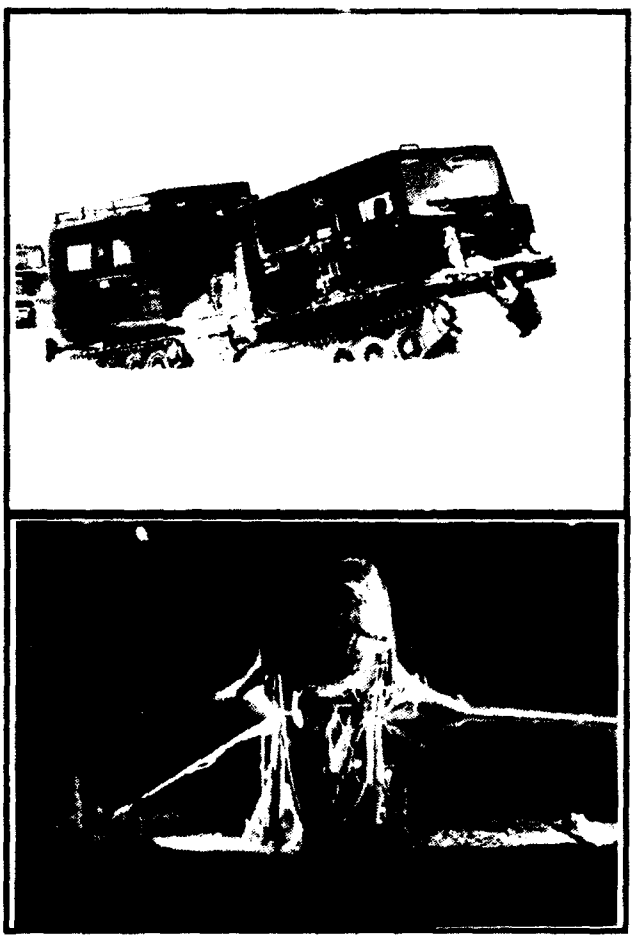
Topography :

Terrain: Tundra, muskeg, lakes, ponds, discontinuous permafrost, low shrubs, stunted black spruce, glacier-fed streams and rivers, nearby mountains, glaciers, treeless barrens, very few roads. Portions of the range area consist of a flat gravel river bottom and flood plain.

Climatic Features: average annual precipitation, 11.63 inches water; average snowfall, 38.71 inches; 92° F high, -69° F low. Subzero temperature 64 percent of the time 1 October through 31 March. Brief calm, clear, intense, cold periods are followed by strong south to east warming winds.

Facilities :

Data reduction and analysis are accomplished by use of desk top computers (i.e., HP 9816 and HP 9845) and shared use of an IBM 4331 computer system. Support facilities include vehicle maintenance shops; instrumentation and photographic facilities; and a calibration laboratory. An atmospheric sciences laboratory meteorological team is attached. The airfield on the installation will handle aircraft up to C-5A. Artillery firing may be conducted to ranges of 50,000 meters. Vehicles may be tested over all categories of winter and summer arctic and subarctic terrain.



Typical Cold Weather Tests

DUGWAY PROVING GROUND (DPG)

MISSION

Testing chemical warfare and biological defensive systems and protective items, incendiary devices, and characterization of smokes and obscurants and relevant systems. The DPG supports testing of conventional munitions and air vehicles.

LOCATION

Dugway Proving Ground, Utah, is located 87 miles southwest of Salt Lake City.

Smoke/Gas Testing

CAPABILITIES

Topography : DPG comprises 1,315 square miles contiguous to 900 square miles of Air Force test ranges and extensive, unoccupied, federally owned land.

Terrain Features:Large expanses of level area, extending into sand dunes, hilly and mountainous zones. Elevation from 4,215 to 7,068 feet above msl. Parts of the salt flats are water-logged in winter. Vegetation absent on salt flats to low brush, grasses and brush to juniper stands with ascending elevation. Ecological data base maintained since 1951.

Climatic Features: Average 50 days/year of precipitation (.01 in. or more); avg. snow/year 17 in; avg rain/year 6.8 in; avg high temp 65 F; avg low temp 38 F; avg wind velocity 6 knots; avg humidity 59%. Visibility exceeds 10 mi 95% of time; storms rare and short.

Ranges :

Dugway Proving Ground tests the military value of chemical weapons, CW/BD items, flame and smoke weapons, soldier compatability, and conventional munitions. DPG conducts joint operational tests, and development tests as well as studies to improve test facilities, instrumentation, procedures, test technology/research in chemistry, life sciences, meteorology, ecology and environmental enhancement. Instrumented grids for small and large tests with power/communications occupy 1315 sq mi plus 900 sq mi USAF Range in restricted air space. Automated meteorological systems are linked to ADP and control center. Artillery/missile/mortar ranges may be used for firing up to 65 km with recovery capability to 30 km. The ranges are equipped for evaluating velocity, pressure, trajectory, impact, functioning/malfunctions, rate of descent. Bunkers, conditioning chambers and instrument pads are available in the ranges. Support items include large inventory of vapor/aerosol samplers, assay labs, radar/cinetheodolite and high speed telescopic tracking, ballistic cameras, movable samplers and towers, weather services. Also instrumented chambers for complete span of environmental, accelerated storage tests, some for challenges with chem/bio agents in total containment. Capability available for physical and rough handling tests of explosive items; transfer/mixing/decon of agents; fluorescent air tracer tests; explosion protection/blast effect tests; sole facility in DoD for aerosol challenge of BD systems with pathogens. Airfield suited for all aircraft, furnishes routine services.

Main Range Areas. DPG ranges can be instrumented to determine velocities, pressures, trajectories, impact functioning, rate of descent, malfunction evaluation, and telemetry of data.

Mortar Range. Facility for firing 4.2-inch, 81-millimeter, and 60-millimeter mortars, each equipped with velocity towers and remote firing equipment.

Howitzer Range. Facility for firing large-caliber weapons.

German Village and Extended Ranges. The primary artillery range consists of three prepared gun posi-

tions that will accommodate present Army artillery weapons (self-propelled and towed), smear and tracking camera facilities, firing bunker, ammunition-conditioning chamber pads, radar position and survey instrument observation points for range, and deflection and functioning data.

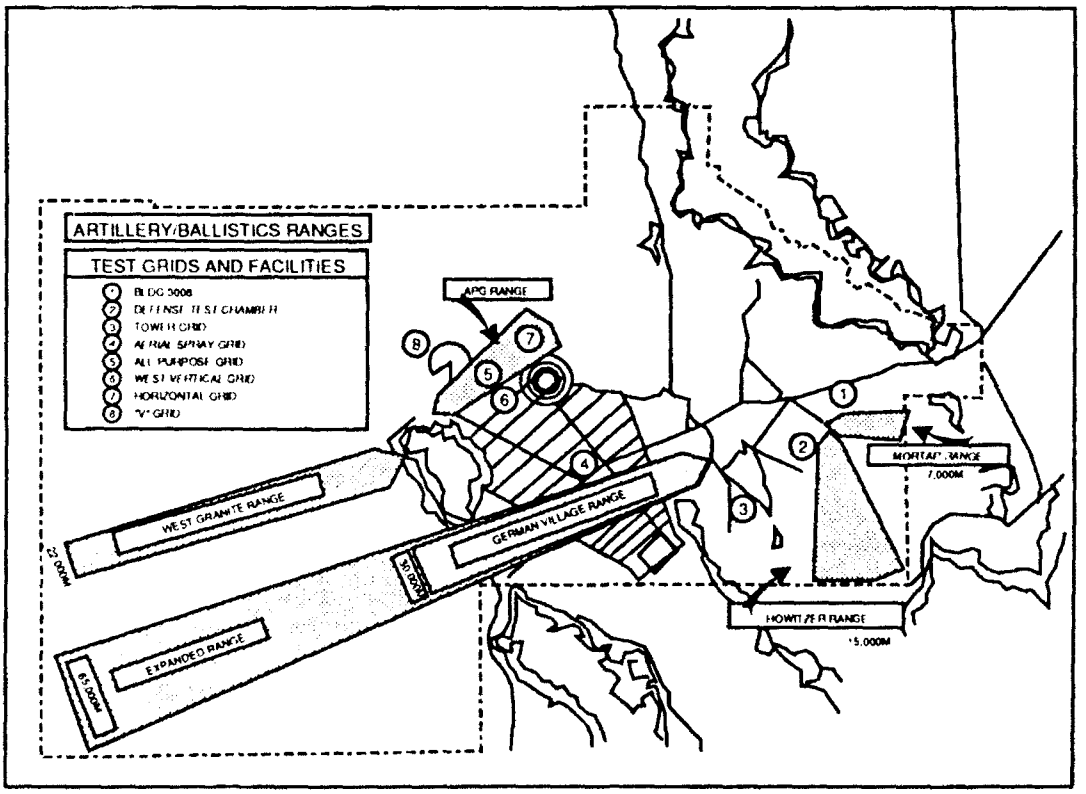
West Granite Range. This range was developed for firing of chemical projectiles into an impact area that could be contaminated.

Facilities :

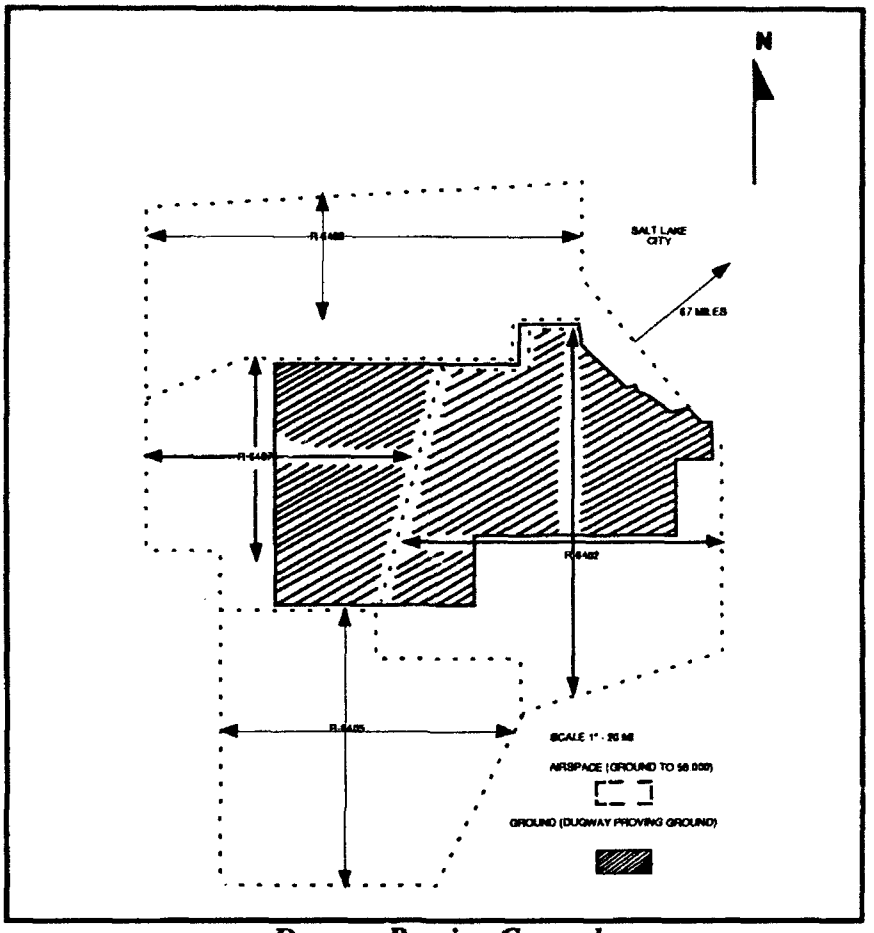
Laboratories. The DPG has two large laboratories for challenging, testing, and performing research in chemical warfare and biological defense programs. The chemical laboratory complex is in compliance with Army Regulation 50-6, "Chemical Surety Program," and is used to test small items or components in a toxic chemical environment. The Life Science Laboratory complex is uniquely designed to test biological detection and protection systems with pathogens and simulants.

The Chemical Laboratory provides 20,000 sq ft of space devoted to assessment of field samples for chemical agents and simulants and specified physical tests and chemical test technolgy in support of field tests. The facility provides an environment for safe work with highly toxic chemicals and radioisotopes. It is capable of performing applied technology studies in analytical, organic, biochemical and physical chemistry, and in special chemical problems of toxicology and pollution detection/abatement. Instrumentation permits both routine mass assay of specimens for trace quantities of chemicals and assay of unique samples. Equipment is available for a wide range of laboratory-scale tests required in the engineering evaluation program and evaluation of materiel to agent penetration. Chemical field tests are supported by filling and analyzing samplers, development and calibration of samplers, developing and improving analytical methods, tests of decontaminants, of decontamination procedures and analyses of agents and simulants.

The Environmental and Life Sciences Laboratory Facility is housed in a building of approximately 35,000 square feet. It is fully equipped to provide laboratory support to biological defense and biological aspects of engineering evaluation tests. Equipment exists to support toxicological, epidemiological, ecological and pollution abatement investigations and laboratory conduct of field tests with physical/fluorescent tracers as well as airborne biological particulates of simulant microorganisms. The facility is equipped with containment of pathogenic microorganisms as aerosols (either in newly-acquired dynamic "biotron"-acro-



Artillery Ballistics Ranges



Dugway Proving Ground
(Airspace Reservation)

sol chamber or the static aerosol, reyniers chamber) with supporting equipment, such as negative air pressure, personnel hoods, autoclaves, a sewage treatment plant, and air incinerators. This facility is the sole remaining one within DoD for conducting studies with aerosols of infectious microorganisms. Also, it contains a 200-liter fermentor with supporting equipment to produce sufficient quantities of nonpathogenic bacterial slurries that simulate pathogenic ones.

Carr Facility. Building 3008. Two rooms in this facility are designed so that items of equipment can be tested in a chemical environment.

Defensive Test Chamber. The chamber provides a self-contained, controlled environment permitting entire items and systems to be subjected to various chemical, biological, and environmental challenges (temperature, humidity, rain, wind, and solar radiation). The chamber (30 by 50 by 20 feet) can accommodate equipment up to the size of the M1 tank.

Tower Grid. This grid is used for chemic.. field tests to determine munitions efficiencies and behavior from a point source release. Howitzer rounds of rockets are fired from platforms to detonate in the center of the grid. Concentration of airborne vapor, particulates, and liquids can be determined.

Aerial Spray Grid (ASG). This area consists of three separate grids (ASG, Downwind Grid, and Ballistics Grid) for testing aerial spray tanks.

- West Vertical Grid. Used for small point source detonated chemical munitions and particulate dissemination to study area dosage patterns.

All Purpose Grid (APG). Used in evaluation of aerial spray, bomb release, multiple point sources, and ground line sources.

Horizontal or Smoke Grid. Used for the test and

evaluation of both fixed and dynamic smoke generating sources. Highly specialized instrumentation determines particle sizes, light transmission, and obscuration.

Toroid Chamber. Identical to the chambers at Fort Detrick, Frederick, MD; Suffield experimental station, Suffield, Canada; and Microbiological Research Establishment, Porton, England. The chamber has a volume of 600 liters. Temperature can be controlled over a range from 30 deg F to 110 deg F (+/-5 deg). Relative humidity control, 5 to 95% (+/-5%) at high temperatures and 20 to 80% (+/-10%) at low temperatures. The chamber is built on a rotating drum principle which allows for a greatly increased suspension time for aerosols of small particles (1 to 5 microns in diameter). Aerosol parameters of microorganisms can be studied in this chamber.

Provides information on viability decay of pathogenic and nonpathogenic microbiological aerosols under a variety of conditions of temperature and relative humidity.

Defensive Test Chamber Facility can accommodate equipment as large as a main battle tank, and has the following environmental testing capabilities within the chamber: temperature: -25 deg F to +125 deg F ± 3 deg; relative humidity: 45% to 90% over temperature range; can lower to 10% at +95 deg F to 125 deg F; Rain: 1 to 12 inches per hour; sunshine: meets MIL-STD-810; air flow: up to 650 feet per minute. The chamber filters all air incident to the chamber, thus can accommodate chemical, biological and allied simulants and agent environmental and materiel testing.

Physical Test Facility providing vibration equipment and instrumentation, physical measurements and rough handling equipment, X-ray equipment, and pentrometers for measuring gas life of CB filters. Vibration tests are accomplished on electrodynamic and mechanical vibrators. The facility has two 6,000 lb electrodynamic shakers with complete instrumentation, one 1,200 lb electrodynamic shaker complete with instrumentation and capable of high altitude operation to 50,000 ft. Three mechanical shakers are mounted in chambers to accomplish gaynes bounce tests. The facility has a complete range of standard measuring instruments for determination of physical measurements of test items. Instruments to measure center of gravity and moments of inertia of projectiles are provided. The facility has a remote controlled drop tower, incline impact machine, and a mechanical shock machine that will provide an impact shock force of 500g on a 1,000 lb test package. Two X-ray machines are maintained for examining munitions and munition components.

Physical Test Support has 20 mobile and fixed environmental chambers, including altitude, temperature, humidity, and fungus. Equipment for x-ray, vibration, shock, inertia, and center of gravity is available.

Communication and Telemetry. A wide range of test communication and microwave data links (narrow and wide band). Range timing in IRIG "B" code is transmitted, and "A," "E," and "H" can be provded.

ADP Support provided by DPI 705 with IBM 360/20, UNIVAC 9300, link to WSMR.

Resources :

Photo Instrumentation
Mobile Tracking Photographic Telescopes
Radiographic X-Ray System
Air Surveillance Radar
Plan Position Indicator
Low Velocity Wind Tunnel
MuzzleVelocity Radar
Video Metric System
Self Propelled Howitzers
Image Analysis System
Vibration System

TYPICAL PROJECTS SUPPORTED

Projectile, 155-millimeter Smoke (XM-825) Protective Mask (XM-30)
81-millimeter Smoke Round (XM-819) Protective Mask (XM-29/30)
Binary Chemical Bomb (BIGEYE) Projectile, 155-millimeter Binary IVA
Ground Launched Cruise Missile Jet Exhaust Decontamination System
8-inch Projectile (XM-736)

POINT OF CONTACT

Commander
U.S. Army Dugway Proving Ground
ATTN: STEDP-PO
Dugway, UT 84022

Telephone:
AUTOVON: 789-3531
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ELECTRONIC PROVING GROUND (EPG)

MISSION

Plan, conduct and evaluate testing of all types of Army ground and airborne communications electronics (CE), electronic warfare intelligence (EWI), optical/electro-optical (O/EO), radioactive detection (radiac), identification, electronic detectors, meteorological, surveillance, and communications systems and equipment. Includes environmental testing, electromagnetic compatibility (EMC), and compromising emanations (TEMPEST) and radar detection, resolution, ranging, and tracking of manned and unmanned aircraft. Interoperability testing aspects of complex Command, Control, Communications, and Intelligence (C^3I) systems are included.

LOCATION

The Electronic Proving Ground (EPG) is a tenant at Fort Huachuca, in southeastern Arizona, 70 miles southeast of Tuscon.

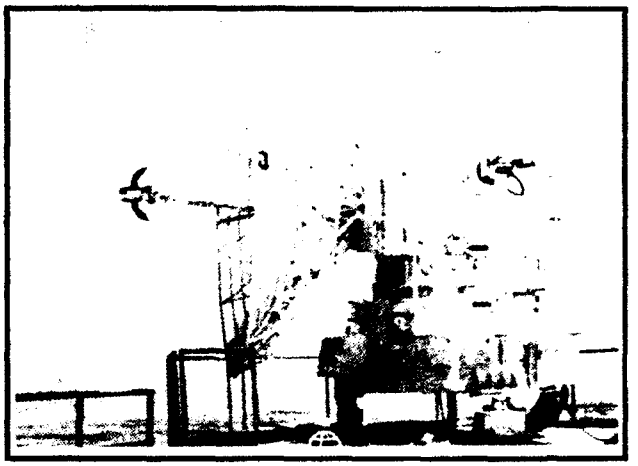
CAPABILITIES

Topography : Real estate includes more than 70,000 acres on Fort Huachuca, 23,000 acres at Wilcox Dry Lake, and 1.5 million acres near Gila Bend.

Area includes mountains, plateaus, and river bottoms. Huachuca Mountain area slopes east to San Pedro River. Shrubs and some grasses grow in low areas. Grass is heavier and oak trees common as elevation increases. Yellow pine trees grow above 6,500 feet.

High elevation and summer showers provide mild year-round climate. Annual rainfall is 16" with 65% in summer, 14% in winter with infrequent light snow, 80% of possible sunshine received. January mean 46.2°F; June mean 76.7°F. Average wind 5.6 mph.

Restricted Airspace. 1,000 square miles of restricted airspace over instrumented range for tests of CE, navigational, and surveillance systems.



EPG Target Tracking Range

Ranges :

The Instrumented Test Range (ITR) is available to support testing of surveillance devices, navigation and communication equipment, and other electronic guidance and control systems. The ITR is especially adapted to tests where the devices of the systems being tested are carried in manned or unmanned aircraft. Tests usually require determination of space position and flight characteristics of the aircraft and require facilities for launching and controlling unmanned aircraft. The ITR provides several flight areas, launch instrumentation, control centers, and tracking facilities grouped into three major instrumentation complexes. Major complexes include precision tracking and surveillance radar systems, telemetry data systems, command/control systems, optical tracking systems, and air-to-ground and other communication systems. Major complexes are interconnected with a multichannel microwave radio relay system. Services provided include range-wide communication, telemetered data, precise timing, the space position and flight characteristics of manned and unmanned aircraft throughout most of southern Arizona, and in support of national ranges covering an area in portions of five states.

Technical Expertise:

Expertise in planning, coordinating, conducting and reporting testing of communications, electronics, and O/EO systems and equipment and radiacs and metorological systems.

Facilities :

EPG facilities are specialized and grouped by the type of commodity evaluated with evaluations including human factor, engineering, reliability, availability, maintainability, safety, and soldier-operator-maintainer test considerations.

Electromagnetic Environmental Test Facility. The Army's principal facility where equipment, systems, and concepts are tested and evaluated in a simulated electromagnetic (EM) environment, including electronic countermeasures. The facility includes an automated electromagnetic data base, deployment, and analysis capability, the weapon system EM environment simulator, spectrum signature facility, voice scoring facility, voice interference analysis system, and automatic data collection system.

Communications Test Facility. Provides fixed plant and field capabilities for testing analog and digital communications equipment and systems under controlled conditions.

Radar Geometric Fidelity Facility. Has a matrix used to determine the accuracy of area mapping airborne radar systems.

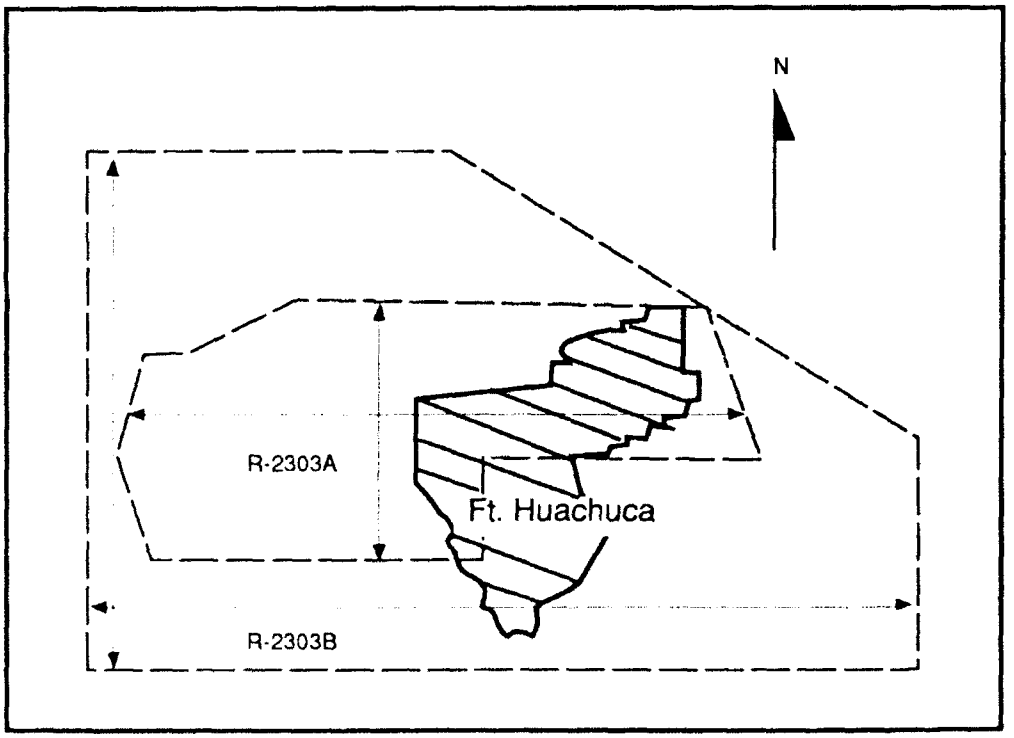
Infrared and Optical Test Facility. Has capability to perform modulation transfer analysis of O/EO devices.

Mobile Research, Development, Test, and Evaluation (RDT&E) TEMPEST Test Facility. Used for open field testing of Army tactical CE systems that process or produce classified information for compromising emanations.

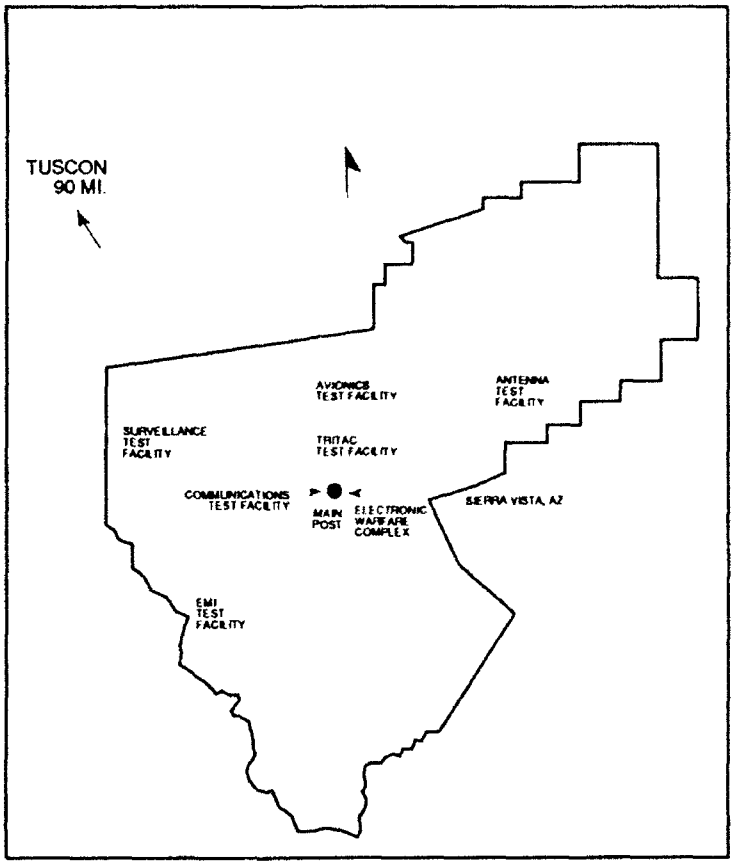
Remotely Piloted Vehicle (RPV) Facility. Proviues data instrumentation for the Army's ongoing RPV programs.

Image Interpretation Facility. Provides image interpretation and analysis for airborne sensor projects, such as combat photographic, infrared, and imaging radar sensors.

Antenna Pattern Measurement Facility. Consists of a 114-foot nonmetallic tower, which can be used to test electronic equipment or antennas at 25-foot increments from 0 to 100 feet. The facility also includes a 117-foot, sensor-bearing nonmetallic arc (75-foot radius) and turntable ca-



Electronic Proving Ground, Ft. Huachuca
(Airspace Reservations)



Electronic Proving Ground, Ft. Huachuca
(Reservation Boundry)

pable of determining antenna patterns of various radiating devices in their operating position (such as aircraft in flight).

Radar Spoke and Radar Resolution Facility. Allows simultaneous measurement of range and azimuth resolution of a test-radar. A moving target simulator track permits controlled and standardized measurement of threshold velocity and radar cross section of radar equipment.

System Test Facility (STF). Used to control, monitor, and acquire data from test aircraft using the Instrumented Service Range. The STF consists of an operations control center, tracking and surveillance radars, and mobile radar facility for coverage in test areas blocked by the mountain ranges.

Electronic Support Measures Range and Vulnerability Testing. Maintains 70 accurately surveyed sites in and around Fort Huachuca, Wilcox Dry Lake, and Tucson, Arizona, which can be used as active signal emitter sites or passive receiver sites allowing accurate measurement of electronic warfare (EW) and signal intelligence systems, direction-finding and location capabilities, or real world sensitivity. Additionally, specialized equipment (jammers) are available to allow field vulnerability testing of various radar communications and communications, command, and control systems during equipment and system development.

The Operations Control Centers located at Fort Huachuca, Oatman Mountain, and Mount Lemmon are equipped with instrumentation to provide control and coordination of manned and unmanned aircraft systems testing conducted on the systems test facility. Testing can be accomplished either independently or jointly, depending on test requirements. Each control center is remotely interconnected with the instrumentation and test control functions at each complex or certain items of test support equipment. The control centers are interfaces to a microwave system which consists of 24 channel capability between Fort Huachuca and Mount Lemmon and 12 channels between Mount Lemmon and Oatman Mountain. This system provides test control communications, remote use of UHF and VHF radio equipment for long-range flights, and data transmission from the Oatman-Mount Lemmon complexes for display at Fort Huachuca.

Control and displays in the Fort Huachuca station include tracking radar plotting data (XYZ), latitude and longitude real-time displays and printouts, surveillance plots, TLM meters/recorders, timing command control, and various type (VHF, UHF, HF) communications. The Oatman and Mount Lemmon complexes have similar capabilities. All data can be provided on a video display. Display is provided to range safety.

TYPICAL PROJECTS SUPPORTED

Tactical Radios
Electronic Countermeasures Systems

POINT OF CONTACT

Commander
U.S. Army Electronic Proving Ground
ATTN: STEEP-MT-T
Fort Huachuca, AZ 86513

Telephone:
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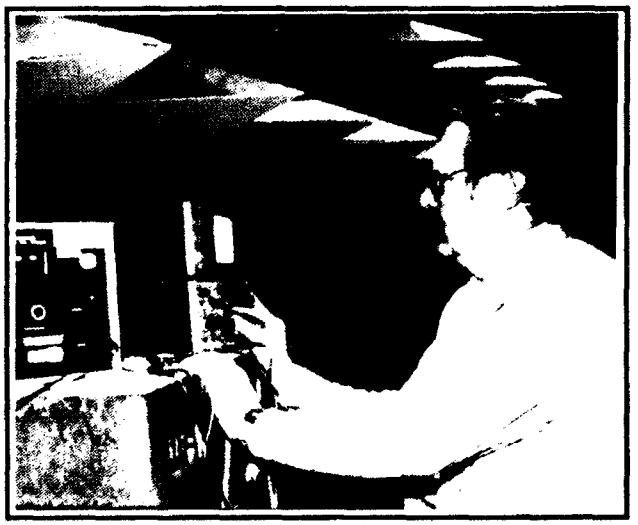
Commercial: (602) 583-6016

Pre Flight Check



Test Monitor

JEFFERSON PROVING GROUND (JPG)

MISSION

Conduct acceptance and R&D tests on munitions to include artillery, armor defeating, mortars, grenades, mines, pyrotechnics, small arms, recoilless, rockets, and other assigned materiel.

LOCATION

Near Madison, Indiana.

CAPABILITIES

Topography :

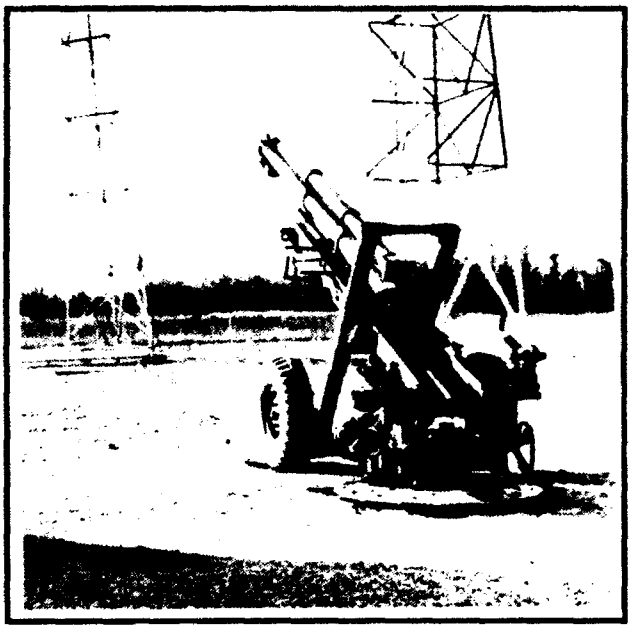
Terrain: Relatively flat terrain varies from 825 to 900 feet above sea level. Soil is a variation of silt and loam. Uncontrolled rough timber growth is prevalent.

Climatic Features: Average number of days per year of precipitation (.01 inches or more) 57. Average annual snowfall, 16 inches; average annual rainfall, 28.35 inches; average high temp. 76° F; average low temp. 35° F. Wind velocity up to 10 knots 71% of time. Mean humidity of 69.41.

Fifty-one thousand acres utilized for explosive areas and test firing ranges.

Facilities/Ranges :

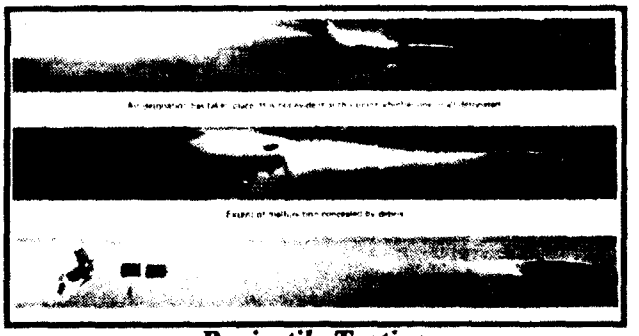
Communications, instrumentation, and electrical power to accommodate all types of weapons and ammunition tests from small arms up to and including 240mm. Maximum firing range 21,000 meters up to 43,000 ft. restricted airspace. Each test area provided with all the necessary facilities such as reinforced concrete gun bays, personnel shelters and test control station to permit full gamut of performance. Additionally, each area has maintenance and servicing facilities to support tests being conducted. Impact fields equipped with observer bunkers with appropriate instrumentation to acquire and record test data. Capabilities to meet laboratory test requirements in accordance with MIL STDS are maintained. Combined configuration and inventory of sensory instrumentation provides a unique capability which affords flexibility and quick response to the varying requirements of munition testing. An IBM 4331 is linked to an IPL 4433 at Aberdeen Proving Ground, Maryland for transmitting test information. Variation in weather, terrain and vegetation at this location provides the capability to conduct most types of the Army's conventional munitions testing.



Typical JPG Artillery Test

Planned New Facilities/Capabilities :

Automation of the data acquisition system to provide a communication link from five major test sites to central S&E computer and near real time reduction and analysis of test results. Modification of MPQ-32 radars for ballistic tracking of projectiles to acquire range data and realtime velocities; target scoring system for measuring target accuracy.



Projectile Testing

U.S.A.

KWAJALEIN MISSILE RANGE (KMR)

MISSION

Provide and operate a national range in the Kwajalein Atoll to support onsite ballistic missile defense R&D programs, strategic offensive weapon system developmental and operational testing, and data collection for the DoD intelligence community.

LOCATION

The Kwajalein Missile Range (KMR) control center is located in the Pacific Ocean at the Kwajalein Atoll, 600 miles north of the equator; 2,200 miles southwest of Hawaii; and 4,300 miles from the California coast.

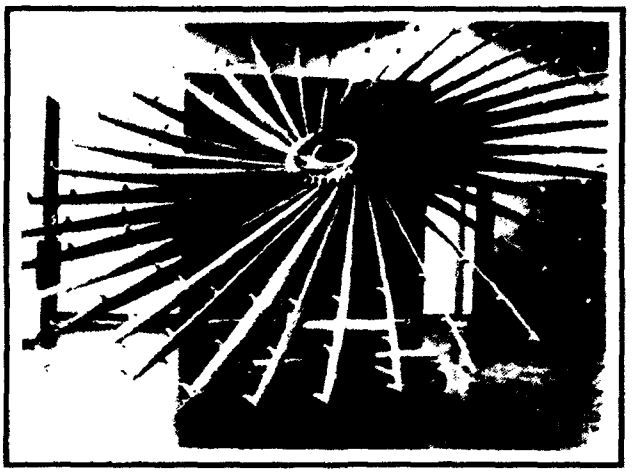
CAPABILITIES

Topography :

Strategic Offensive Weapon System Development and Operational Testing. The location of Kwajalein (distance from California), low density of populated areas, large lagoon area for recovery operations, and complement of state-of-the-art instrumentation provide the capability for realistic operational testing and development of strategic offensive and defensive weapon systems.

Intercontinental Ballistic Missile Target Area. Since the KMR serves as a target area for major intercontinental ballistic missile (ICBM) systems, it is an ideal location for studying and collecting data on reentry phenomena. Major ballistic missile defense (BMD) facilities have been located at the KMR since 1961 and have been collecting data for technology development and testing candidate systems in a realistic environment.

Intelligence Data Collection. The location of the KMR and its sophisticated instrumentation make it a prime station for early detection of foreign launches and tracking during early orbits or precise trajectory and signature measurements of suborbital launches. The Kiernan Reentry Measurements Site (KREMS) complex also is available for space object identification through radar-imaging techniques.



Experimental ABM Warhead

Ranges :

Extended Range Support. A capability has been developed, in support of the Peacekeeper ICBM program, to score reentry vehicle impacts in the broad ocean area near the KMR. Deep ocean transponders have been implanted and accurately surveyed; these communicate with surface sonobuoys. The sonobuoys transmit impact data to a receiver system aboard KMR aircraft. Low-altitude telemetry data also is collected from antennae and receivers onboard KMR aircraft.

Kiernan Reentry Measurements Site. Extremely sophisticated radar systems with Target Resolution and Discrimination Experiment (TRADEX), ARPA Lincoln C-Band Observable Radar (ALCOR), and ARPA Long-Range Tracking and Instrumentation Radar (ALTAIR) located on Roi-Namur Island at the northern tip of the Kwajalein Atoll. These systems provide a wide spectrum of radar measurements for analysis. The Millimeter Wave Radar, completed in early 1983, expands these capabilities.

Metric Data. The KMR has the capability to determine the position of a reentering vehicle to extreme accuracy by combining data from one or multiple radar systems with data from highly sophisticated optical systems, such as Super Recording Automatic Digital Optical Tracker (RADOT). Six Super RADOTs and six ballistic cameras collect angle data.

Scoring. Two splash-detection radars provide coverage both inside and outside the lagoon. In addition, bottom-mounted hydrophones provide both scoring data and time-of-impact data.

Recovery. The Kwajalein Atoll encompasses the world's largest lagoon; average water depth inside this lagoon is about 200 feet. By using a small submarine, a well-equipped diving barge, and scuba divers, reentry vehicles are recovered routinely.

Facilities :

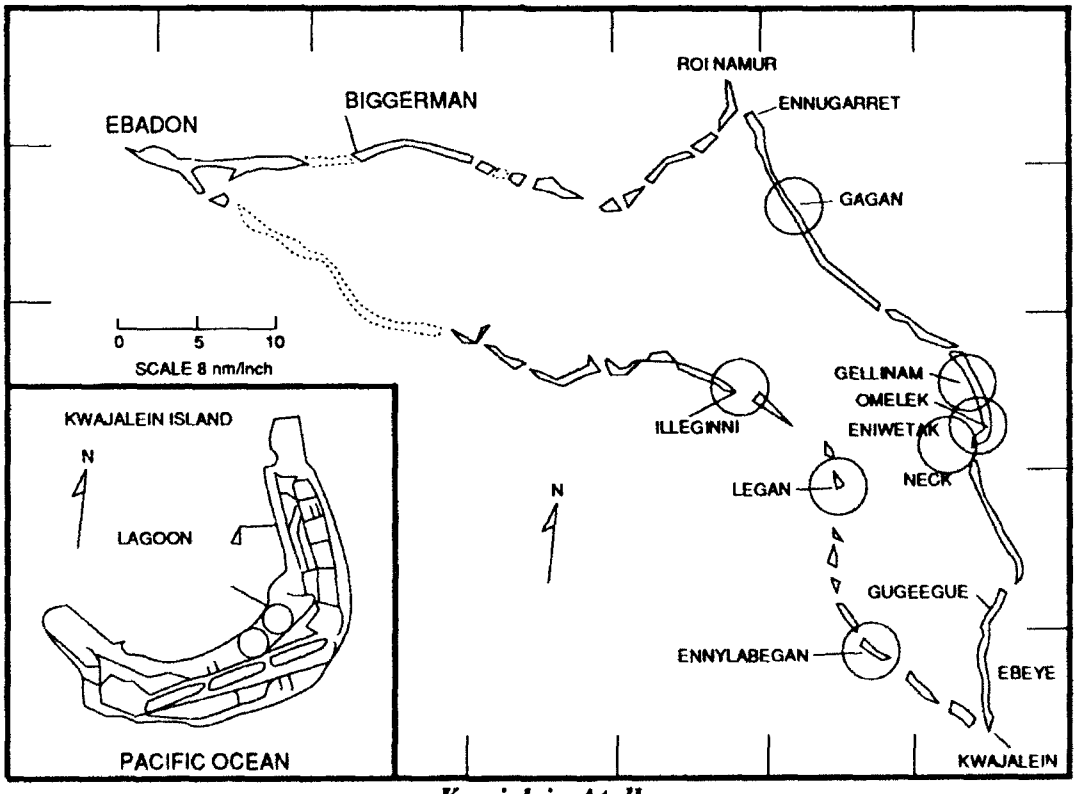
KMR has the most sophisticated signature and metric data collection capability in the free world. A complete spectrum is available for observation and analysis of reentering objects to permit discrimination between similar types such as reentry vehicles and penetration aids. UHF and VHF data are available from the ALTAIR radar, L-Band and S-Band from the TRADEX radar, C-Band (narrow band and wide band) from the ALCOR radar, and 35 and 95 GHZ data from the millimeter wave radar.

Telemetry. Eight tracking antennas optimally located with multiple receivers, polarization diversity, decommutators, recorders, data separation, and display systems provide the telemetry reception capability.

Communications. A digital microwave system interconnects range and range user instrumentation facilities with voice and data-handling capabilities up to 44.736 mb/s. An AN/FSC-78 satellite ground station provides up to 24 voice and data channels between the KMR and Camp Roberts, California; 24 voice and data channels between the KMR and Wahiawa, Hawaii; and one high-speed data channel (1.544 mb/s) between the KMR and New Boston, New Hampshire. The high-speed data transmission capabilities in use at the KMR are highly flexible and can be adapted to varying range user requirements.

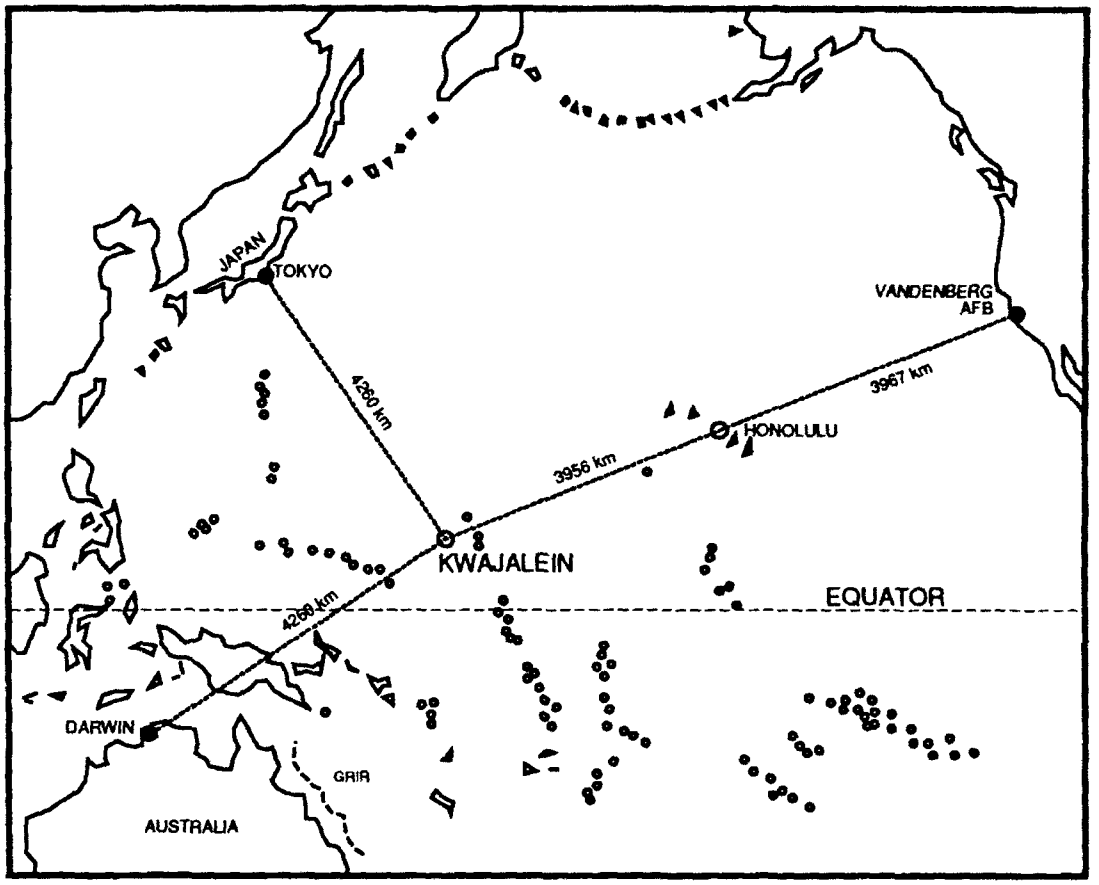
Planned New Facilities/Capabilities :

Multiple-target instrumentation radar; laser ranging for Super RADOTs; upgraded weather analysis system; high altitude optical measurements platform; upgraded CYBER 76/6400 system.



Kwajalein Atoll

U.S.A.



PACIFIC OCEAN AREA

Pacific Ocean Area

TYPICAL PROJECTS SUPPORTED

Safeguard Ballistic Missile Defense Systems
Air Force ICBM Systems, Developmental and Operational
Navy SLBM Systems, Developmental and Operational
Advanced Ballistic Reentry Systems
Army BMD Advanced Technology Programs
Defense Nuclear Agency Test Programs
Saturn/Apollo/Soyuz/Skylab/Shuttle/Titan - NASA Test Programs
Japanese Space Program
USAF Space Detection and Tracking System

POINT OF CONTACT

Commander
Ballistic Missile Defense Systems Command
ATTN: Kwajalein Missile Range Directorate
P.O. Box 1500
Huntsville, AL 35807

Telephone:
AUTOVON: 742-3100
Commercial: (205) 895-3100

TROPIC TEST CENTER (TTC)

MISSION

Plan and conduct tropic environmental phases of development test on munitions, rocket and guided missile systems, surveillance and target acquisition systems, fire control, combat vehicles and other automotive materiel, general equipment (e.g., generators, air-conditioning equipment), chemical/biological protective equipment, and other assigned materiel. Conduct methodology investigations designed to improve test operation procedures.

LOCATION

Fort Clayton, Panama.

CAPABILITIES

Topography :

Terrain: Undulating uplands with dissected hills, 50 to 600 feet in elevation. Drained and undrained lowlands. Tropic moist forest, red and white mangrove in saltwater marsh. Extensive savanna. Mostly heavy-textured soil (clay and silty clay) with scattered medium (silt loam) and light-textured soils (loamy sand).

Climatic Features: Average number days per year of precipitation (0.1 inches or more) - - 275°, average annual rainfall (inches) - - 70 on Pacific side; 120 on Atlantic side; average temperature (F) - - high 88; low 72°, mean relative humidity - - 75% to 95%; average wind velocity - - 4 to 30 mph, 80 percent of time.

Facilities :

Laboratory capabilities include chemistry, microbiology, soils, materials, instrumentation, human factors, data analysis, and imagery. Thirty-five range facilities are available for firing and explosive tests with communications and electrical power to accommodate all types of weapons and ammunition tests from small arms up to 155 millimeter gun. Maximum range is 4 kilometers within reservation and up to 75 kilometers when firing into the Caribbean Sea. Included are areas and facility groupings devoted to fragmentation and demolition testing, armor and rocket testing. Test areas are available for mobility performance and endurance testing of combat vehicles and automotive and related equipment.

Data reduction support is provided by an IBM 4331 computer remote entry to a computer at Aberdeen Proving Ground. Test support includes trade shop fabrication and modification of test fixtures.

Tropics Training in Panama

U.S.A.

WHITE SANDS MISSILE RANGE (WSMR)

MISSION

Provide and operate an overland range to support research and development (R&D) testing of the Army, Navy, Air Force, National Aeronautics and Space Administration (NASA), and other approved U.S. government agencies and foreign governments. Plan and conduct development testing and evaluation of Army missiles, rockets, and materiel systems.

LOCATION

The White Sands Missile Range (WSMR) is located in south-central New Mexico. The headquarters area, in the southwest corner, is located 50 miles north of El Paso, Texas, and 25 miles northeast of Las Cruces, New Mexico. Extended range launch complexes are located in southeast Utah and southwest Idaho.

CAPABILITIES

Topography : The main area of the WSMR under government control is 40 miles wide (east to west) and 100 miles long (south to north). Another 40-mile area contiguous to the north end of the range can be called up under lease agreements. Extended range facilities are located in southeast Utah (approximately 500 miles ground range) and in southwest Idaho (approximately 800 miles ground range). The range includes flat desert, hilly and moutainous areas.

Climatic Features: Semi-arid with a visibility that is usually unlimited except for terrain. WSMR climatic annual mean values are: cloud cover 0.4%, temperatures of max-mean-min are 76-62-46°F, relative humidity is 37%, precipitaiton is 9.6 in; snowfall is 6.5 in, and wind velocity is 7 mph with max gust to 70 mph.

Terrain Features: In south-central New Mexico, a generally flat terrain 40 (W-E) X 100 (S-N) miles at 4000 ft msl; sandy desert with sparse ground cover; 5000-9000 ft mountains parallel WSMR E and W and crosses W to E approximately 75 mi N of launch complexes. Additional WSMR related launch areas located at McGregor range, Green River, Utah, and Shoofly, Idaho, have similar terrain and provide support for overland missile flight trajectories of up to 800 miles.

WSMR Missile Range

Ranges :

WSMR provides and operates DoD's largest over-land national range; tests and evaluates Army missile and rocket systems; supports development tests of the Army, Air Force, Navy, NASA, and other agencies; controls all electromagnetic radiation devices on and adjacent to the range; conducts R&D pertaining to range instrumentation; and operates nuclear and high energy laser system test facilities.

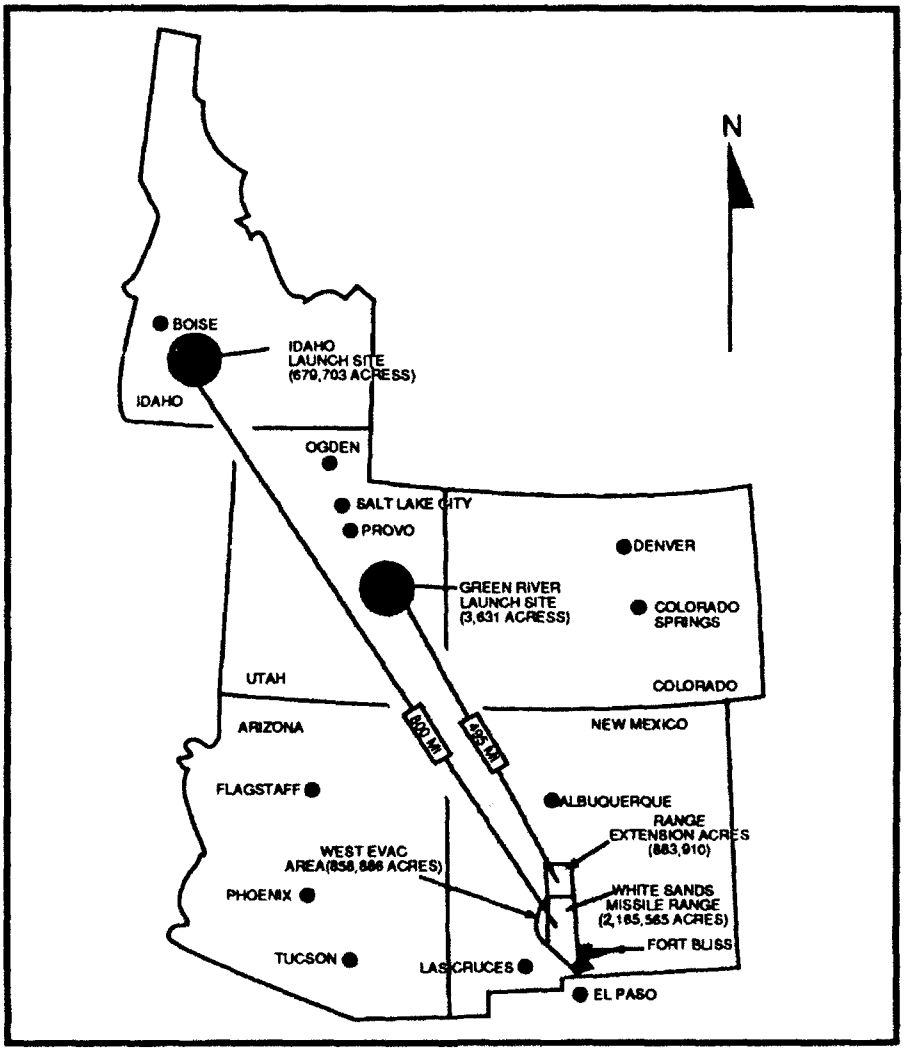
WSMR contains major test facilities, labs, many launch sites, extensive major instrumentation and test equipment, film and video optical data recording systems, an ADP facility with data processing systems for real-time and deferred test data processing, and over 2000 monumented instrumentation points surveyed to an accuracy of 1/250,000 to 1/1,000,000. These capabilities are supplemented by tenant organizations' capabilities, and controlled restricted air-space over WSMR, adjacent extension areas and launch sites in Utah and Idaho. Capabilities are available to: store ordnance and propellants; assemble missiles; provide exact timing; test in controlled or simulated environments or in a static mode; provide ground and aerial target support with multiple target formations; perform system simulations; launch missiles and drones; detect and track objects in flight; measure trajectory, attitude, and event; provide telemetry and flight safety; communicate throughout the range; record and evaluate data; locate impact and recover components; and provide for hazardous explosive tests.

The majority of the surface-launch facilities are located along the southern portion of the main area. High-speed, high-precision optical systems are concentrated in this area to support the initial trajectory requirements. Air-to-air and air-to-surface testing is conducted in the midrange area where long focal-length optics are available. Two hazardous impact areas are located in the mid and upper area of the range, which are used for impacts of various ground-launched and air-launched missiles. The terrain is generally flat, sandy desert with sparse ground cover, which facilitates recovery of test items. Extended range testing from Utah and Idaho can be supported with mobile instrumentation systems configured for the particular test requirements.

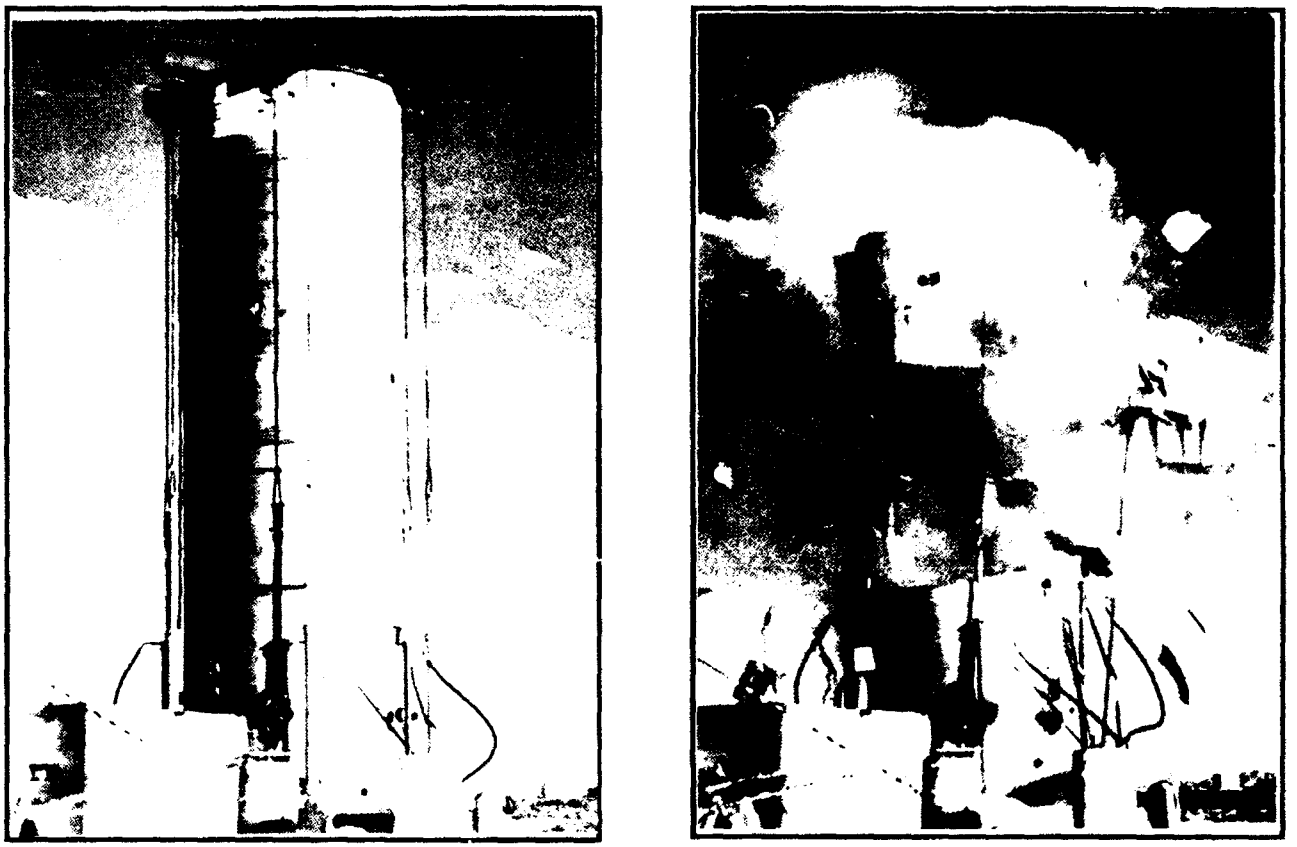
Facilities :

WSMR operates and maintains laboratories and facilities to produce and examine the effects of climate, weather, the upper atmosphere, transportation, seismic shock and vibration, static electricity, electromagnetic radiation, nuclear detonations, and electronic or optical countermeasures on selected systems and components. Hazardous test facilities have been centralized and relocated at the south end of the main area. Mobile equipment is available to combine multiple climatic, dynamic, and electromagnetic testing of materiel at the firing areas and launch pads. Computer-simulated testing of weapon systems can be performed before actual firings are accomplished.

High-Energy Laser Test Facility. A DoD facility being constructed in the southern portion of the main area will have the capability to test and evaluate the new family of directed energy devices.



White Sands Missile Range Extended Launch Capability



Titan IB Before and After Photos of HE Laser Shot

Tenant Organizations. Various tenant organizations provide an additional level of expertise and capabilities. Organizations such as the Navy, Air Force, NASA, Atmospheric Science Laboratory, Office of Missile Electronic Warfare, and Office of Test Director conduct tests and support on-going testing.

Resources :

Over 2,000 monumented instrumentation points surveyed to an accuracy of 1/250,000 to 1/1,000,000 are located within the main area. An on-going effort in mobilizing instrumentation systems affords the WSMR the capability to configure instrumentation support to test requirements. These systems include optics, radar, telemetry, communications, and computational control. Available instrumentation includes:

Rate Table with Roll Features
TEKTRONIX 4081 Graphics Display System
Thermal Unit
Cinetheodolite
Infrared Radiometer
Electron Linear Accelerator
Interferometer
Spectrometers
Vacuum Chamber
Bathythermograph
Contraves Systems
Laser Aided Tracker
Precision Shock Machines
Vibration Exciters
Hot Chambers
Telemetry
Plotting Boards
Radar Trackers
Digital Range Tracking Systems
Temperature Shock Chambers

TYPICAL PROJECTS SUPPORTED

The many categories of weapon systems testing include surface-to-surface, surface-to-air, air-to-surface, air-to-air, low altitude cruise systems, high-altitude probes, antiballistic missiles, reentry vehicles, nuclear effects testing (including high explosive effects), and automation of airborne and surface targets to facilitate tactical realism. Internal and external instrumentation support systems can be configured to gather continuous data throughout the test.

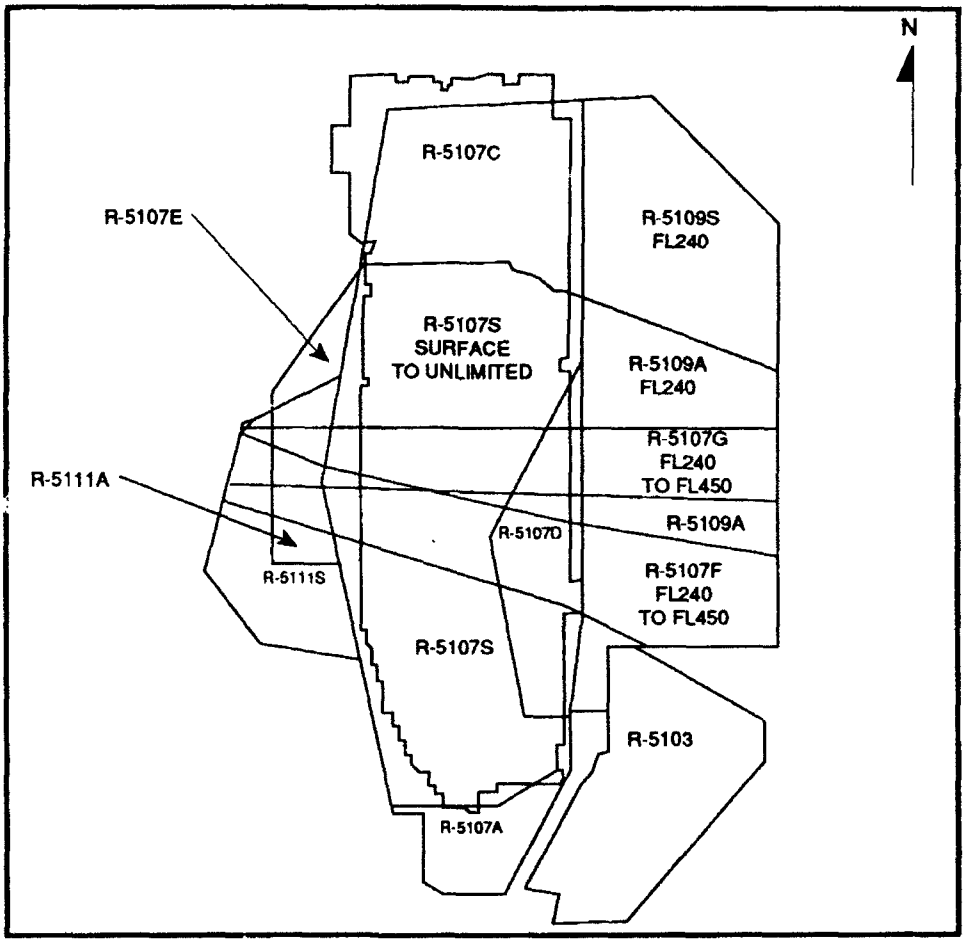
PERSHING IA and II Army Surface-to-Surface Missiles
NIKE ZEUS/SPRINT/LOADS - Ballistic Missile Defense System
HAWK/PATRIOT/STINGER/CHAPARRAL - Army Surface-to-Air Missiles

Standard Missile Test - Navy - Surface-to-Air
AEROBEE 150/350 - Navy - Surface-to-Air
Space Shuttle - NASA
AIM 7/9 Series - Air Force - Air-to-Air Missile
Advance Location Strike System - Air Force - Air-to-Surface
Short Range Attack Missile - Air Force - Air-to-Surface
Defense Nuclear Agency - High Explosive Testing

POINT OF CONTACT

Commander
U.S. Army White Sands Missile Range
ATTN: STEWS-PL
White Sands Missile Range, NM 88002

Telephone:
AUTOVON: 258-5755/3715
Commercial: (915) 678-5755/3715



WSMR Restricted Air Space Areas

NOTES: 1. ALL AIR SPACES RESTRICTED FROM SURFACE TO UNLIMITED UNLESS OTHERWISE NOTED.

2. AIR CORRIDORS R-5107F & 5107G ACTIVE ONLY WHEN RELEASED BY WSMR.

U.S.A.

YUMA PROVING GROUND (YPG)

MISSION

Support testing of long-range tube artillery, aircraft armament and air delivery systems and equipments, air movable equipments, and natural desert environmental phases of development testing of all classes of defense materiel for the Department of Defense and other government agencies.

LOCATION

Southwestern Arizona, next to the Colorado River.

CAPABILITIES

Topography : The Yuma Proving Ground (YPG) comprises 1,400 square miles of the Sonora Desert, which is comparable to the great deserts of the world. The area is an ideal location for testing materiel in a desert environment.

Climatic Features: The climate at YPG permits nearly year round use without interruption caused by precipitation or freezing temperatures. High ambient temperatures allow extreme desert climate testing. Yearly climate means: temp max 87 F, min 60 F; precipitation 3.35 in, max 6.40 min 0.19; relative humidity max 52% min 18%; cloudless 244 days, thunderstorms 11 days; wind 5 mph, max 71 mph gusts; solar radiation 524 langleys/day.

Terrain Features: Bare steep bedrock mountain blocks comprise 30% of area; elevation several hundred to 2778 feet. Intervening lowlands dominantly gravelly, some sand plains; elevations 200 to 1600 feet. Vegetation sparse desert shrub; some trees to 20 feet high.

Ranges :

The Aircraft Armaments Range is a fully instrumented air-to-ground and ground-to-ground aircraft armament test range with electronic and optical instrumentation, including six precision aircraft tracking systems (PATS-laser tracker), tracking radars, and video scoring. The range has six sites from which the position of missile-firing aircraft can be established by position-locating system radars and trajectories of missiles measured.

YPG Vehicle Testing

The Artillery Firing Range/KOFA Range consists of three primary test areas:

The Main Front area with 21 permanent firing positions, ammunition storage and preparation, and environmental simulation facilities.

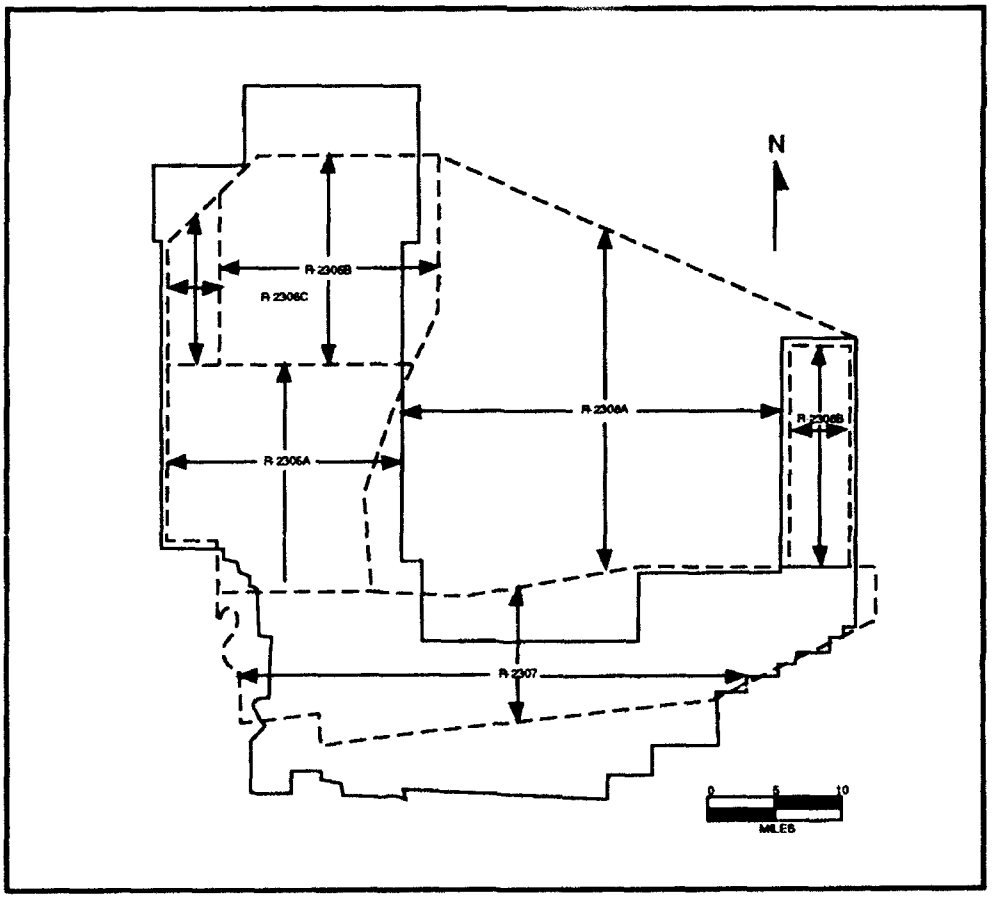
Terminal Ballistics Evaluation Area with prepared and instrumented impact area.

Extended Range Munitions Area. Maximum range attainable is 75,000 meters with 65,000 meters under tracking surveillance.

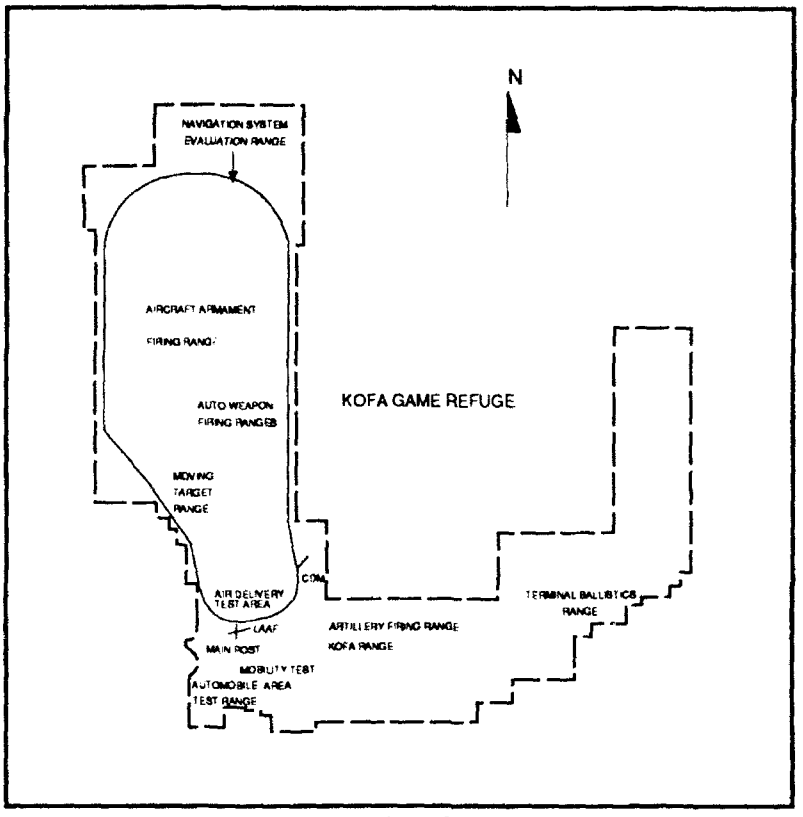
The Range is located in the SE part of YPG and extends from E of highway 95 to the E boundary. The range is approximately 6 miles wide and extends 65,000 meters west to east over dedicated land and 74,000 meters when impacting in the N portion of the east leg and over-firing the KOFA game refuge. The range is equipped with optical and electronic instrumentation to acquire both interior and exterior ballistic data. The range includes 19 instrumented impact areas at various ranges from the firing front. The Muggins mountains to the south and KOFA wildlife refuge to the north as well as the restricted airspace from the surface to 80,000 feet over the E leg and unlimited restricted airspace over the instrumented range provide safety and security barriers. The 9 km firing front is divided into 12 permanent firing positions capable of accommodating sophisticated instrumentation equipped in accordance with test requirements. In addition, there are 300 other precisely surveyed firing positions within the range.

The Air Delivery Test Area permits total air drop and air transportability (under the connotation of air delivery) testing of all classes of materiel (including ammunition). Tests are conducted using three separate drop zones and a water impact zone for dynamic testing from aircraft, and a controlled impact facility for static (free-fall) drop testing of materiel up to 35,000 pounds from heights of 70 feet. All drop zones in the area are fully equipped with electronic and optical instrumentation.

The Automatic Weapons and Ammunition Test Ranges provide up to 4,500 meters of direct fire at large (30 feet by 60 feet) variable-obliquity armor, cloth, and aluminum plate targets; horizontal impact areas up to 500 meters square; and sod, diced earth, mud, sand, and macadam fuze graze function targets. Movable firing positions provide complete facilities for test operations, instrumentation, and ammunition conditioning. Any degree of elevation can be



Yuma Proving Ground
(Airspace Reservation)



Yuma Proving Ground

allowed to ranges of 10,000 meters or more.

The Navigation System Evaluation Range is a 15 by 60 kilometer instrumented range configured to provide real-time space position and event data of moving aerial and ground platforms for the evaluation of navigation systems.

The Moving Target Range features a remote-controlled, rail-mounted, target carrier with speeds up to 30 miles per hour for testing of ground vehicle-mounted direct fire weapons at ranges to 3,000 meters and aircraft weapon systems at slant ranges to 5,000 meters.

Facilities :

The Vehicle Performance Measurement Facilities are eight special test courses over natural desert terrain, prepared test slopes and obstacles, a 2-mile paved dynamometer course, water spray simulation, vehicle swimming basins, mud basin, and extensive instrumentation for testing wheel and tracked vehicles, components, fuels, and lubricants.

The Climate Simulation Facilities comprise seven environmental chambers available for various exposures, including high and low temperatures, humidity, altitude, and salt fog. One, the Large Multipurpose Environmental Chamber, has three firing ports for functioning weapons systems up to 40 millimeters under controlled climatic conditions.

The Real-Time Data Acquisition System The field instrumentation consists of four installed laser trackers, two radars, three meteorological towers, and a position locating system, all sending data in real time to two real-time computers driving a graphics display network. Additional facilities include:

- Telemetry Stations,
- Measurement Laboratory,
- Controlled Impact Test Facility,
- Calibration Laboratory, a
- Materials Analysis Laboratory,
- Large Multipurpose Environmental Chamber, and
- Nightvision Test Facility.

Computer Systems.

UNIVAC 1106
PDP 11/35, 11/55, 11/70
32/77 Multistream Super Minicomputer

Resources :

Instrumentation :

Cinetheodolite sites, fixed and mobile linked by a real-time data transmission, reduction and display test net.
Ballistic Measurement System.
Doppler data system with doppler velocimeter radar.
Radar Set Illuminators
Overhead Video Scoring System
Position Location System
Aided Laser Tracking
Vibration Systems
Dynamometer Test System
Acoustical Measuring System
X-Ray Units

Targets :

Moving and stationary target arrays.

TYPICAL PROJECTS SUPPORTED

Heliborne Missile (HELLFIRE)
Tube-launched, Optically Tracked, Wire Command/ COBRA Air-to-Ground Missile System
LANCE Ground-to-Ground Missile System
M1 ABRAMS Tank
Trucks for Bradley Fighting Vehicle System
Ammunition Projectiles (warheads/fuzes)
NAVSTAR/GPS
Advanced Attack Helicopter
Tactical Trucks

POINT OF CONTACT

Commander
U.S. Army Yuma Proving Ground
ATTN: STEYP-MMI
Yuma, AZ 85364

Telephone:
AUTOVON: 899-3111
Commercial: (602) 328-3111

U.S.A.

ATLANTIC FLEET WEAPONS TRAINING FACILITY (AFWTF)

MISSION

Operate, maintain, and develop weapon training facilities and services in direct support of the training of Fleet forces and other activities and for the test and evaluation of weapon systems.

LOCATION

The Atlantic Fleet Weapons Training Facility (AFWTF) is a tenant shore activity at the Naval Station, Roosevelt Roads, Puerto Rico. It is located approximately 45 miles east of San Juan, Puerto Rico, and has four different operational ranges that are distributed throughout adjacent Atlantic Ocean and Caribbean Sea waters and the eastern part of the Island of Vieques, Puerto Rico, with remote instrumentation sites in the U.S. Virgin Islands and Puerto Rico's adjacent islands.

CAPABILITIES

Topography : The AFWTF is a major range capable of supporting Fleet training and testing for a wide spectrum of naval warfare. It consists of four distinct land and water operational ranges fully instrumented to safely control exercises and to assess Fleet readiness and weapon systems performance whether airborne, surface, or subsurface. It has the capability to prepare, launch, present, recover, and recycle airborne, surface, and undersea targets for Fleet training and OT&E.

Ranges :

The Outer Ranges, consist of the ALFA and BRAVO operating areas, provide the open ocean area and airspace volume for exercises and tests involving a single or multiple participants. The combined sea area encompasses about 200,000 square miles, and the land mass, including islands, smaller cays, and the Roosevelt Roads Naval Station, exceeds 33,000 acres. Missile operations, air and surface gunnery, and other exercises are conducted under a simulated tactical environment for maximum realism. Operations are controlled from the Range Operations Center (ROC), located

SM2 Missile Firing

within the AFWTF headquarters at the Naval Station, Roosevelt Roads. A central command and control system electronically displays pseudo real-time information using 16 color, computer-controlled viewing screens at the ROC which record the tactics used by ships and aircraft operating against several different subsonic and supersonic aerial targets. The ROC is capable of Navy Tactical Data System (NTDS) links with fleet units and maintains communications with all exercise participants.

The Inner Range consists of air-to-ground, naval gunfire support (NGFS), and supporting arms target complexes in addition to amphibious training areas located ashore within adjacent waters on the eastern portion of the Island of Vieques, Puerto Rico. Operations are controlled from the observation post at Cerro Matias, Vieques. The range is employed primarily for conventional weapons firing against ground (static or mobile) land and sea targets (MLT/QST) and two BULLSEYE targets provided for air-to-ground inert ordnance drops. BULLSEYE target two also is a designated bomb dummy unit target. Practice mining operations are conducted within the adjacent waters to the north and south of the Inner Range complex. Six point targets and two area fire targets are provided on Three Hills and along the south coast of Vieques for NGFS operations.

The Underwater Tracking Range (UTR) is an instrumented, underwater tracking facility, consisting of a

Control Center at Sprat Hall, St. Croix, U.S. Virgin Islands, an 82-square nautical mile acoustic tracking range, and an optical tracking range. The UTR primarily is used for ASW exercises, weapons systems accuracy trials, fleet operational readiness accuracy check site operations (FORACS), MK-48 torpedo certifications exercises, and various surface and underwater RDT&E projects. Shore instrumentation provides precision, real-time, three-dimensional tracking for multiple-submerged objects simultaneously. The optical range is used basically for FORACS. Mobile underwater targets (MK-30) are provided for maximum realism. The MK-30 includes magnetic anomaly detection capability for aircrew training. Torpedo air-drops, surface launches, and ASW rocket firings are conducted.

The Electronic Warfare Range (EWR) is an integrated complex of threat platform simulators (TPS) intended primarily for the training of Fleet ESM operators. The EWR provides a realistically simulated hostile electromagnetic environment for the training of Fleet EW teams and a tactical electronic order-of-battle in support of exercises conducted within all the AFWTF Ranges. Exercises provided include integrated combat system exercises and antiship missile defense exercises using EW augmented aircraft, the At-Sea Simulator Platform (converted utility landing craft) equipped with TPS site and underwater noise simulator as well as strategically located shore-based TPS sites. The EWR has been employed successfully for DT&E and OT&E projects.

Facilities :

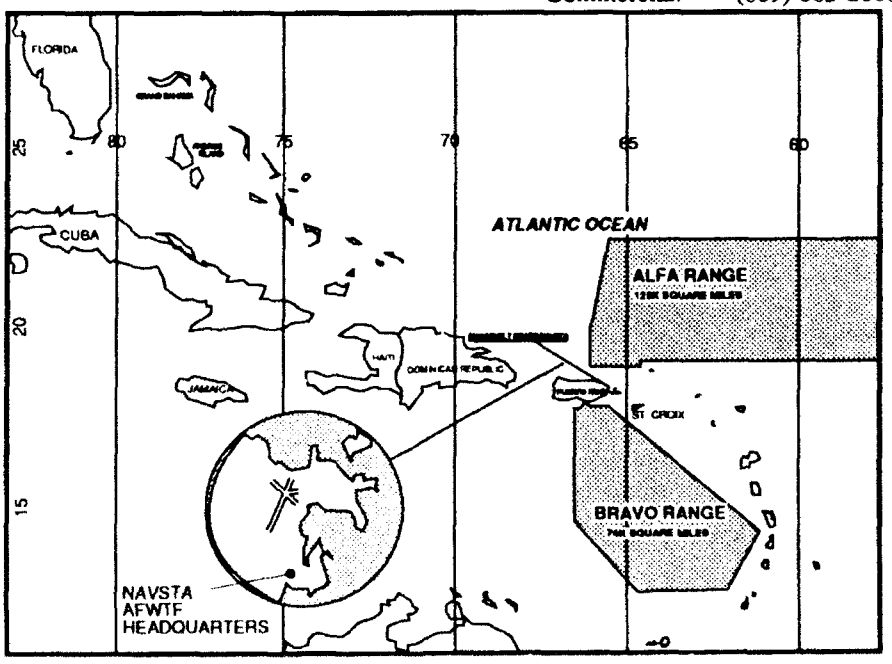
The Naval Station, Roosevelt Roads, and Fleet Composite Squadron EIGHT (VC-8) provide several supporting functions that relate directly and are indispensable to the functioning of the AFWTF. Also, a field office of the Fleet Analysis Center is responsible for receiving missile systems telemetry for analysis.

TYPICAL PROJECTS SUPPORTED

ASROC
HARPOON
Class
PHOENIX
SPARROW
SIDEWINDER
SHRIKE
(ASMD)
Antiship Missile
Defense
Inspection
MK 46/48 Torpedo
DD-963, FFG-7, and SSN 688
Ship Acceptance Trials
Advanced Magnetics Silencing
Project (LINEAR CHAIR)
Fleet Training
Air Antisubmarine Warfare
Tactics
Mine Readiness Certification

POINT OF CONTACT

Atlantic Fleet Weapons Training Facility
FPO New York 34051
Code: 7112
Telephone:
AUTOVON: 831-5316
Commercial: (809) 863-2000/5316



Atlantic Fleet Weapons Training Facility (Outer Ranges)

U.S.A.

ATLANTIC UNDERSEA TEST AND EVALUATION CENTER (AUTEC)

MISSION

Provide, develop, and operate the deep-water facility for underwater acoustic measurements and testing and calibrating sonars, and provide tracking data on ships, submarines, aircraft, and weapons systems, to support ASW and undersea R&D program, assessment, and operational readiness.

LOCATION

The Atlantic Undersea Test and Evaluation Center (AUTEC) is a detachment of the Naval Underwater Systems Center at Newport, Rhode Island. The center is located on Andros Island, Bahamas, with the ranges located in the Tongue of the Ocean.

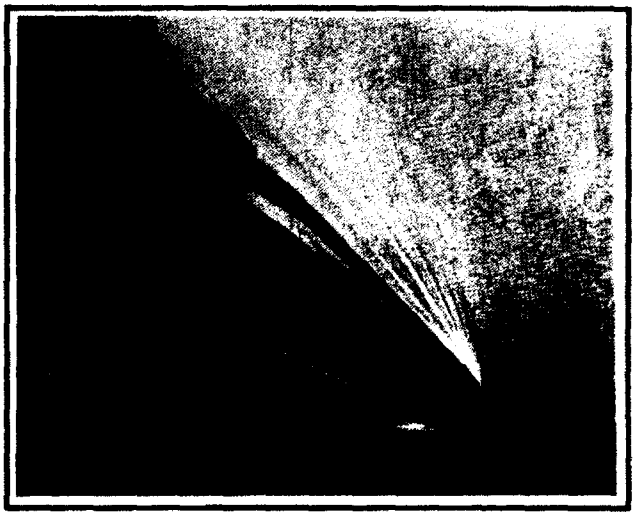
CAPABILITIES

Topography : A uniquely quiet, deep, 800 fathom sheltered body of water approximately 25 x 100 miles suitable for single and multi unit tests.

Ranges :

The AUTEC Weapons Range, a tracking range for ASW system assessments, is capable of providing measurements between subsurface, surface, and air targets for use in evaluating sensors, weapons systems and platforms as well as simulating or stimulating sensors, weapons, and targets. It occupies an area 5 miles wide and 35 miles long with a water depth of 5,000 feet and is supported by five down-range sites up to 50 miles from Main Base.

The Acoustic Measurement Range is the only permanent underwater noise-measuring facility on the east coast. The range is used to detect, record and analyze hydroacoustic noise generated by submarines and surface ships in at-sea conditions. The quiet ambient background is due to sheltered waters, low traffic noise, and restricted area.



Typical Deep Water Project

This allows surface and submarine acoustic programs in support of acoustic silencing, target strength, vulnerability and counterdetectability, and sensor performance programs to be conducted. Signal measurement is accomplished through a moored stable underwater array, cabled to a real-time, shore-based data processing system.

Facilities :

The Fleet Operational Readiness Accuracy Check Site (FORACS V) measures the accuracy of ASW and navigational sensors installed in surface ships, submarines, and helicopters. Measurements provide the repeatable accuracy of shipboard equipment and statistical data for analysis of overall system performance. Sensors tested include sonars, search radars, gun fire control radars, EW support measures (ESM) equipment, gyro compasses, Stellar Inertial Navigation System, periscopes, and peloruses.

The Main Base on Andros Island is the control center for all on-range operations. The Command Control building houses the range control, data acquisition, and data processing equipment for all three ranges. The range support shop provides all on-site facilities.

Air and Surface Craft include the range ship IX 306 and the major torpedo launch platform (with both surface and

submerged launching capability); a 100-foot torpedo recovery craft; YFU 97 and YFU 91 Logistics Support Craft and six other small boats for logistics and personnel transfer; a UH-1N helicopter and two SH-3G helicopters (for torpedo and torpedo-target recovery); and a cargo aircraft for regularly scheduled passenger and cargo transport between Andros Island and West Palm Beach, Florida.

TYPICAL PROJECTS SUPPORTED

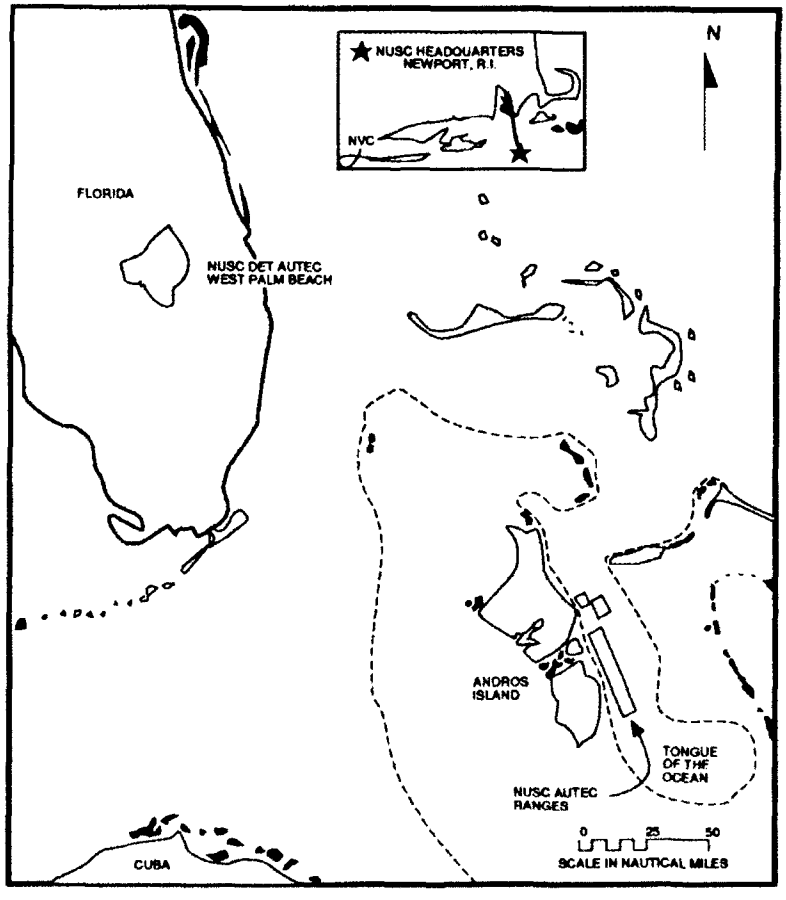
FFG 7 Development and Post Delivery
Torpedo MK 48 Training Certification andAcceptance
Torpedo MK 48 Advanced Capability (ADCAP)
New Ship Class Standardization
Trident Certification
SSN 688/700 Certification
Airborne ASW Developments - P-3C Update
Harpoon Targeting Trials
LAMPS MK III Acoustic Signature Tests
Fleet Ballistic Missile Submarine (SSBN)
Submarine Sonars
Security Technology
S-3A
Mobile Submarine Simulator
SSBN Improved Sonar Processing
Submarine and Surface Ship Silencing Equipment Program

POINT OF CONTACT

The Naval Underwater Systems Center, Headquarters, Newport, Rhode Island, is the scheduling and operating area assignment authority for the Tongue of the Ocean Operating Areas for the Commander in Chief, U.S. Atlantic Fleet.

Naval Underwater Systems Center
Atlantic Undersea Test and Evaluation Center
Newport, RI 02840
Code: 389

Telephone: AUTOVON: 948-4269
Commercial: (401) 841-4269



Atlantic Undersea Test and Evaluation Center Locations

U.S.A.

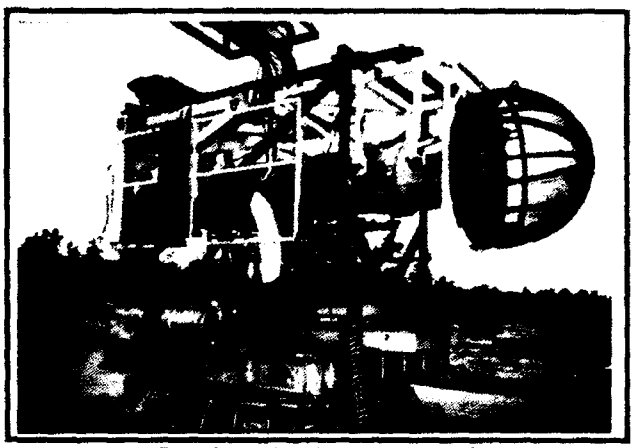
NAVAL AIR PROPULSION CENTER (NAPC)

MISSION

Provide complete tecnnical and engineering support for air-breathing propulsion systems, including their accessories, components, fuels, and lubricants, to the Naval Air Systems Command and the Fleet by managing and performing applied RDT&E.

LOCATION

Trenton, New Jersey



Engine Testing at NAPC

CAPABILITIES

Topography : Large engines (turbojet and turbofan) are tested in three altitude test cells and two sea-level test cells. Small engines (turboprop and turboshaft) are tested in four small sea-level and altitude test cells. Tests are run under simulated operating conditions to verify performance, determine deficiencies, develop corrections to design or service problems, and define operational limitations. All the cells use the same ram air facility, refrigeration systems, and vacuum exhausters and have quick-response inlet and exhaust control valves, fuel temperature conditioners, and real-time data acquisition and processing systems.

Facilities :

The Naval Air Propulsion Center (NAPC) engine test plant facilities can provide simulated test conditions that meet the requirements for all present and planned Navy aircraft engines. The overall conditions that can be simulated are as follows:

- Altitude: sea level to 100,000 feet
- Flight Speed: 0 to Mach 3.0
- Temperature: -65°F to 650°F
- Airflow: 0 to 700 pounds per second

The Auxiliary Test Area is used to test ram air turbines and air-breathing engine components under simulated operational conditions to verify performance, determine deficiencies, develop corrections to design or service problems, and define operational limitations. The major equipment used includes the ram air facility, refrigeration systems, vacuum exhausters, and a real-time data acquisition and processing system.

The Transmission Test Facility is used to develop, qualify, and evaluate the reliability of complete helicopter drive systems under simulated mission operation and to identify and evaluate system-related interface problems. The major equipment used includes an 8,000-horsepower step-up gear box, water brakes, and thrust and bending loading systems.

The Accessory Test Area is used to test auxiliary systems and accessories under simulated operational conditions to verify performance, determine deficiencies, develop corrections to design or service problems, and define operational constraints. The major equipment used includes a high-pressure air compressor, an air heater, motor-generator dynamometers, a variable attitude stand, a burner test rig, a vibration machine, and high and low temperature control fluid systems.

The Rotor Spin Facility provides experimental support for R&D and evaluation programs that pertain to rotor structural integrity, durability, and burst protection. In

this facility, under simulated engine conditions, inexpensive and expeditious component testing is conducted to evaluate, develop, and optimize rotor designs. The major equipment used includes spin chambers, high-speed photographic equipment, induction and radiant heaters, nondestructive inspection equipment, optical temperature-measuring system, turbine drive systems, and real-time data acquisition and processing systems.

The Outdoor Test Site is used to test propulsion systems under gyroscopic loading conditions to simulate the loads imposed by flight maneuvers and to conduct noise tests, infrared signature tests, and engine performance tests in the absence of test cell wall effects. The major equipment used includes the turntable test stand, the gyroscopic test rig, and real-time data acquisition and processing systems.

The Fuels and Lubricants Laboratory is used to support development of propulsion systems fuels and lubricants, preparation of specifications, and solutions of service problems and to conduct fluid systems investigations, measure air pollution, and determine life- and load-bearing characteristics of gear and bearing materials. This laboratory uses a chemical laboratory, a Fluid Systems Test Facility with variable and other drives and hybrid computer, an infrared spectrophotometer, a gas chromatograph, an atomic absorption spectrophotometer, fuel thermal stability cokers, a single element Coalescer Test Facility, a high temperature-bearing test rig, Ryder gear machines, bearing and gear fatigue equipment, an analytical ferrograph, and a pollutant-measuring console.

TYPICAL PROJECTS SUPPORTED

- Engine Performance
- Inlet Distortion
- Simulated Mission EnduranceTest
- Water and Sand Ingestion, Icing, and Humidity Effects
- Service Problem Investigation
- Helicopter Transmission Testing
- Rotor Component Development Program
- Low Cycle Fatigue
- Rotor Burst Containment
- Develop and Qualify New Fuels, Lubricants, and Additives
- Evaluate New Gear and Bearing Material
- Gyroscopic Loading
- Rocket Exhaust Gas Ingestion
- Corrosion Effects
- Fluid Systems Component Testing
- Engine Exhaust Infrared Suppression and Signature Measurement

POINT OF CONTACT

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Trenton, NJ 08628
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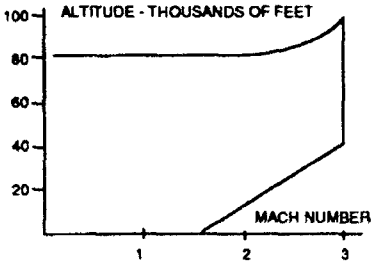
NAPC
FACILITY CAPABILITY



SUMMARY OF TEST CELL CAPABILITIES

CONDITIONS		3E	2E	1E	1W	2W	3W	4W	5W	6W
Airflow (lb./sec.)		700	430	430	350	350	100	100	100	100
Inlet Temp. (°F)	Cold	-65	-65	-65	-65	-65	-65	-65	-65	-65
	Hot	+650	+390	+390	+220	+220	+220	+220	+220	+220
Mach Number		3.0	2.4	2.4	1.1	1.1	1.1	1.1	1.1	1.1
Altitude (ft)		100,000	80,000	80,000	S.L.	S.L.	80,000	80,000	80,000	80,000
Test Area	Length (ft)	30	18	18	56	56	15	20	17	17
	Width/Diam. (ft)	17	14.5	14.5	23	23	8	10	10	10
	Height (ft.)	—	—	—	14	14	8	—	10	10

NAVAL AIR TEST CENTER (NATC)

MISSION

Provide technical and engineering support and facilities for the conduct of life cycle T&E and support of aircraft weapon systems and components for the Department of Defense and other government agencies.

LOCATION

The Naval Air Test Center (NATC) is in Lexington Park, Maryland, on the Chesapeake Bay, 45 miles southeast of Washington, D.C.

NATC Test Areas

CAPABILITIES

Topography: The Naval Air Station is an all-weather landing field. Flight testing is conducted in 50,000 square miles of restricted air spaces over the Chesapeake Bay and offshore operating areas in the Atlantic Ocean. Open sea areas permit ASW system, weapon, and high-Mach testing.

Ranges :

Chesapeake Test Range. Provides precise time-space position information in three axes using computer-linked video, theodolite, radar, and laser tracking equipment. This data is merged with telemetry data from the test aircraft to provide real-time data in corrected engineering units for project engineers. Four streams of simultaneous real-time data are available.

Facilities :

NATC Flight Test Facilities. Provide actual and simulated conditions that meet the requirements for all in-Service and planned naval aircraft weapon system programs. Over 160 aircraft, representing all Navy and Marine Corps aircraft, are supported by RDT&E and Fleet activities. The facilities and capabilities permit Navy and contractor single-site flight and ground testing of aircraft in a sea environment with actual shipboard equipment installations. Included are catapult, takeoff assist, automatic landing aid, arresting gear, and ship-lighting systems for shipboard tactical aircraft. The close proximity of Atlantic Fleet units and operating areas facilitates testing of the complete weapon system: ship, aircraft, weapon, and command and control systems.

Tactical Avionics Software Test and Evaluation Facility. Uses computers to simulate and stimulate the airborne digital environment, thus developing baseline engineering data for efficient T&E and optimization of complex weapon systems, flight control systems, and avionic equipments.

Electromagnetic Environmental Effects Facilities. Provides the capability to fully test electromagnetic interference, compatibility, pulse, radiation hazard, and vulnerability aspects of aircraft weapon systems.

Aircraft Test and Evaluation Facility. Permits fully instrumented ground tests of an aircraft with the engines operating and all aircraft systems operating using the normal aircraft power.

Ordnance Facilities. Provides the capability to test weapon and aircraft compatibility including weapon carriage-release, separation, and accuracy.

Electrical and Electronic Facilities Provides the capability to test aircraft subsystems and components for vibration, shock, contaminant susceptibility, and operation characteristics in controlled environments.

Electronic Warfare Facilities. Includes an EW Integrated Systems Test Laboratory in which a dense threat environment can be generated and enables the aircraft systems performance to be measured against known signal densities. Additionally, range facilities provide precise aircraft antenna and aircraft EW system data on radiation and receive patterns, radar cross section, jam-to-signal ratio, chaff measurements, and warning receiver operation.

Acoustic Test Facility. Provides the capability to simulate desired undersea acoustic phenomena and enables baseline tests of ASW systems without the expensive use of at-sea fleet units. Capability also exists to conduct these tests in a realistic C^3I environment using ASW Tactical Support Center and ASW operation center assets.

Carrier Systems Facilities. Include a C-7 steam catapult and a MK-7 arresting gear system, both representative of shipboard installations. These facilities, along with visual and automatic landing aids, are located at the approach end of runway 31, a sea level site permitting realistic testing in an environment closely representing at-sea conditions. A takeoff assist ramp is used to develop and test short take off techniques.

Test Facility Integration. NATC laboratories and facilities are integrated and can be used either singly or in conjunction with each other by means of a distributed processing cable network.

U.S. Naval Test Pilot School. Provides training to experienced pilots and flight officers in the theory and techniques of flight testing aircraft and airborne systems.

TYPICAL PROJECTS SUPPORTED

Aircraft Mission System T&E
Aircraft Mission Equipment T&E
- System Performance and Integration
- Sensors
- Technical Performance
- Data Processors and Software
- Mission Effectiveness
- EW Hardware and Software
- Human Factors and Safety
- Fire Control Systems

Aircraft Systems and Component T&E
Aircraft Flight Characteristics
- Airframe, Propulsion Flight Control
- Flying Qualities and Performance

Aircraft Maintenance and Logistics
- Carrier and Ship Interface

Contractor Development Programs
- Weapon and Store Compatibility
- Weapon Separation Envelopes

POINT OF CONTACT

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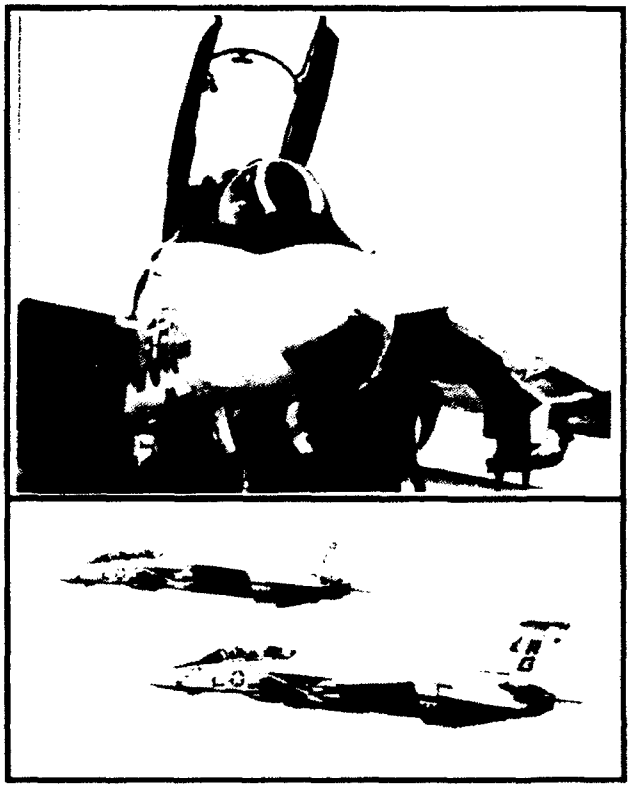
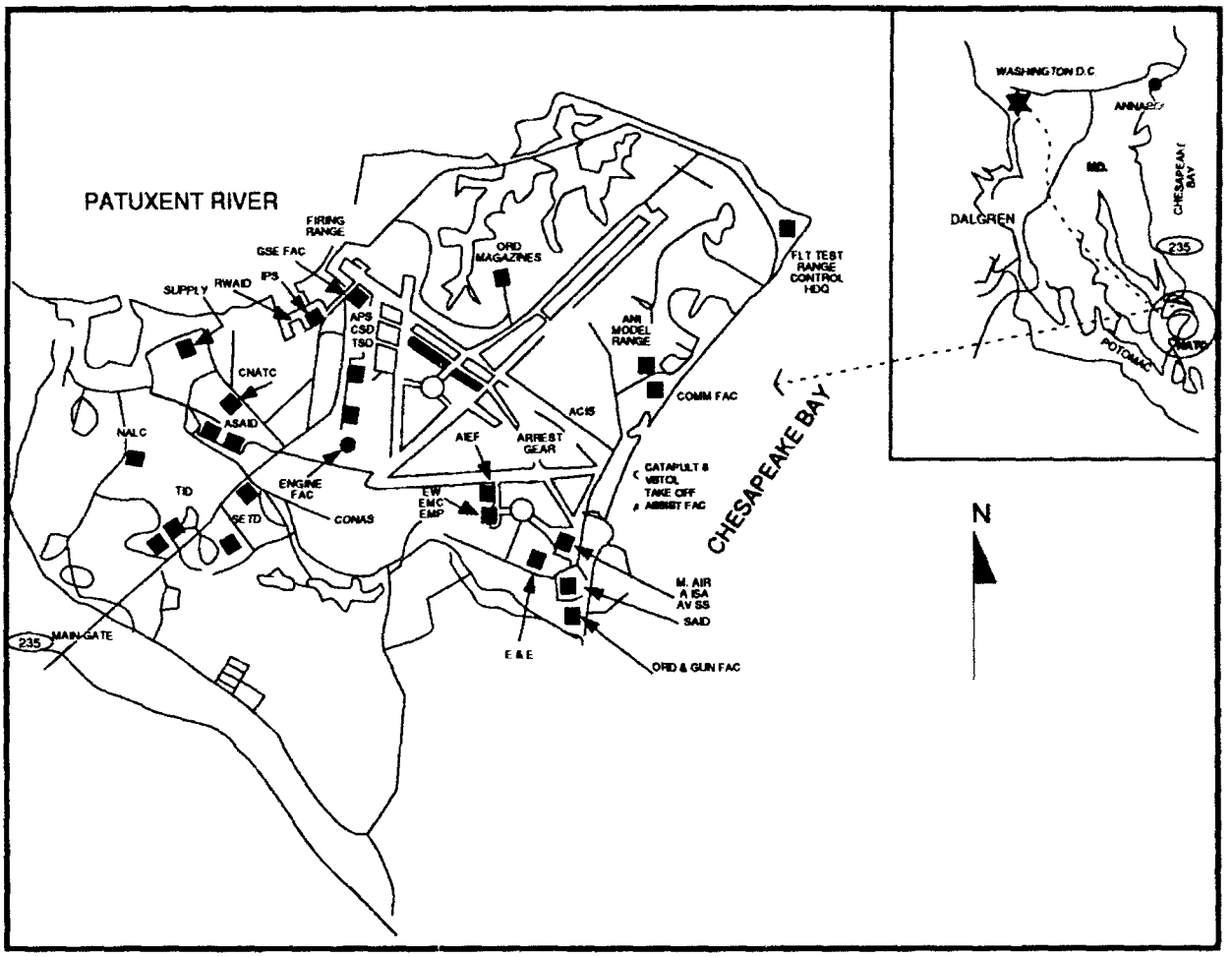


F-14s in Test Program

U.S.A.



Naval Air Center Patuxent MD. (NATC)

ACLS	AUTOMATIC CARRIER LANDING SYSTEM
AIMD	AIRCRAFT INTERMEDIATE MAINTENANCE DEPARTMENT
ASATD	ANTISUBMARINE AIRCRAFT TEST DIRECTORATE
ATEF	AIRCRAFT TEST AND EVALUATION FACILITY
BIS	BOARD OF INSPECTION AND SURVEY
CNATC	COMMANDER, NAVAL AIR TEST CENTER
CONAS	COMMANDING OFFICER, NAVAL AIR STATION
CSD	COMPUTER SERVICES DIRECTORATE
E & E	ELECTRICAL AND ELECTRONIC TEST FACILITIES
EW/EMC/EMP	ELECTRONIC WARFARE/ELECTROMAGNETIC COMPATIBILITY/ELECTROMAGNETIC PULSE FACILITIES
GSE	GROUND SUPPORT EQUIPMENT
NALC	NAVAL AIR LOGISTIC CENTER
APS	AIR OPERATIONS
RWATD	ROTARY WINGS AIRCRAFT TEST DIRECTORATE
SATD	STRIKE AIRCRAFT TEST DIRECTORATE
SESTF	SURFACE EFFECT SHIP TEST FACILITY
TID	TECHNICAL INFORMATION DEPARTMENT
TPS	U.S. NAVAL TEST PILOT SCHOOL
TSD	TECHNICAL SUPPORT DIRECTORATE

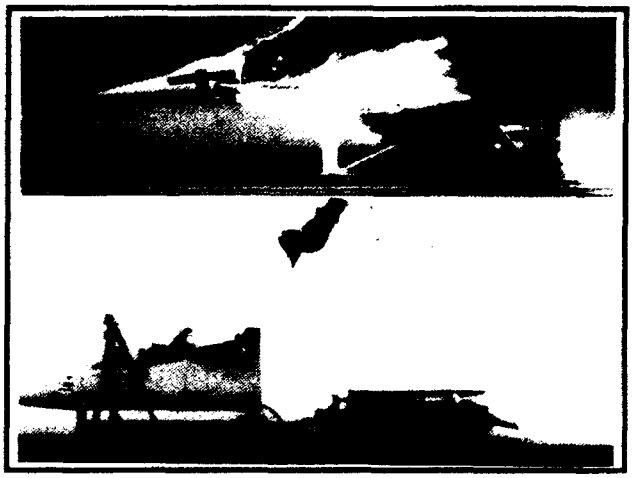
NAVAL WEAPONS CENTER (NWC)

MISSION

Principal Navy RDT&E center for air warfare systems (except antisubmarine warfare systems) and missile weapon systems, and the national range/facility for parachute test and evaluation.

LOCATION

NWC, China Lake, is located in the upper Mojave Desert, 150 miles northeast of Los Angeles, CA.



Representative NWC Tests

CAPABILITIES

Topography : The Center's lands cover more than one million acres of the upper Mojave Desert of Southern California. The climate and geography of these lands are typical of the arid regions of the U.S. Southwest. The weather is usually clear, with very little precipitation and practically unlimited visibility throughout most of the year. The land is barren, consisting mainly of flat dry lake beds, large dry washes, alluvial fans, and rugged mountains. Nearly all the land is used exclusively for test and evaluation or as buffer between sensitive and hazardous tests and the surrounding civilian lands. Most of the heavily instrumented test facilities are concentrated on or near the vast dry bed of a Pleistocene lake, which covers the southwestern quarter of the China Lake area.

The bed of the dry lake is flat and bare, well suited to the delivery and recovery of air- or ground-launched ordnance, and large enough to accommodate several test ranges and missile impact zones.

An 11,000-acre airfield, missile- and drone-launching facilities, high speed test tracks, and the test control and support complex are located on the southern edge of the lake bed. Low mountain ranges rising from the east and north edges of the dry lake provide ready-made elevated sites for tracking and photographic instrumentation. These instrumented sites allow for easy, thorough coverage of test activity on the lake bed and in the air above it. East of the lake, the mountains are cleft by steep canyons and secluded blind valleys that form natural areas for hazardous tests. To the north, volcanic plateaus and the Coso Mountain range provide a varied terrain for a tactical military targets range and a unique look-down and horizontal radar-signature range.

In the Randsburg Wash/Mojave "B" area, to the southeast of the main China Lake area, the terrain is as barren as in the China Lake area, but the surrounding mountains are lower, the slopes gentler, and the valleys larger. This area is well suited to low-level maneuvering by high-speed aircraft; its north and south sectors are also used as aerial gunnery ranges. Randsburg Wash is the largest valley, a 15-mile long shallow bowl surrounded by mountains rising 2,000 to 3,500 feet above its floor. The valley is relatively free of outside electromagnetic interference. The west end of the valley has extensive facilities for research and test of electronic countermeasures, test and evaluation of proximity fuzes, and other activities requiring a quiet RF environment. The east end of Randsburg Wash is well suited for large-scale, high-explosive detonation tests. The floors of other large valleys in this remote area are interspersed with knolls and ridges whose crests are lower than the surrounding mountains but are well above the main layer of ground-heat atmospheric distortion.

Ranges :

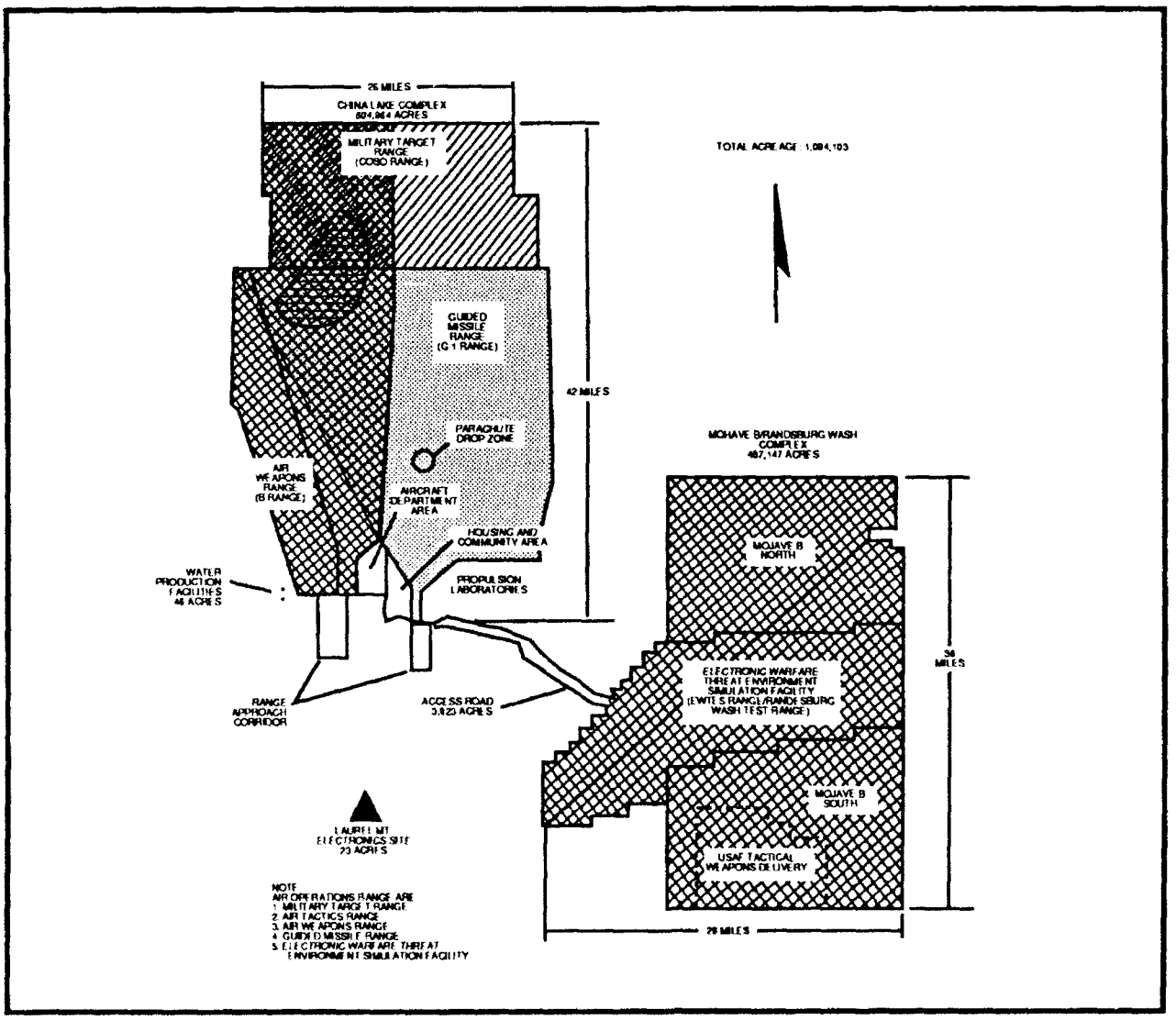
Air Operation Ranges. include the Air Weapons Range, Air Tactics Range, and Military Target Range. The Air Weapons Range is primarily for the test and evaluation of fire-control and bombing systems, guided weapons, air-to-surface missiles, and unguided bombs against fixed and moving ground targets. The Air Tactics Range provides for

development and evaluation of air-to-surface attack tactics and weapon-delivery techniques and for training of Fleet pilots in the use of weapons and tactics.

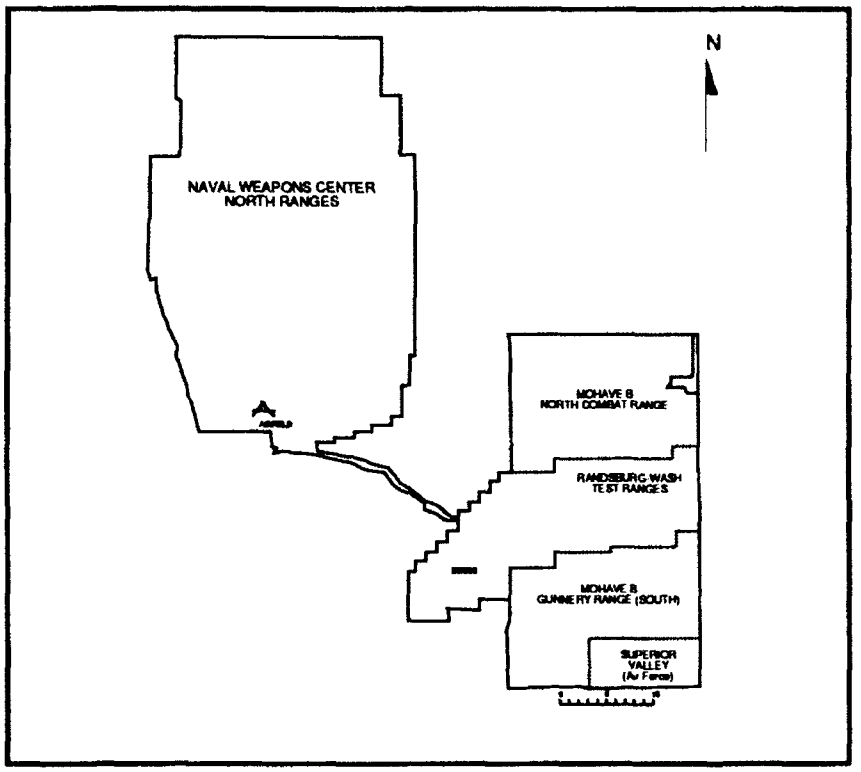
Military Target Range. Affords aircrews the opportunity to train in weapons delivery against such targets as bridges, tunnels, tanks, convoys, surface-to-air sites, and gun emplacements. The range covers about 70 square miles of rough mountainous terrain in the northwest sector of the China Lake complex. Average elevation is about 6,000 feet. Most of the simulated tactical targets are at the 7,000 foot level in a rolling depression surrounded by peaks and ridges rising to 8,000 feet. This physical environment offers the variety of topographic features and weather conditions typical of high mountainous terrain. Bare hillsides alternating with thick brush, and large scattered stands of evergreen trees, frequent broken cloud cover, occasional heavy rainsqualls, and moderate snow cover in winter combine to present aircrews with unexpected, realistic tactical situations that cannot be duplicated at other aircraft test ranges.

Combat Range. The Mojave "B" North Combat Range is used for a variety of testing, primarily air-to-surface systems. The range is remote and includes a "simulated airstrip" and tactical convoys as target areas. No permanent instrumentation is in the area, although portable instrumentation can be used.

Guided Missile Ranges. Used for test and evaluation of air- and surface-launched missiles, guns, fire-control



Naval Weapons Center Ranges and Land Use



Naval Weapons Center

systems, field evaluations of small tactical air-defense systems, and test activities involving potential hazards from experimental and unproven ordnance or from damaged target drones. These ranges also have vertical launch capability.

Ground Ranges. G-1 Range is located in the southeastern portion of the Center's range complex and is approximately 250 square miles in area. The western half of G-1 Range consists of relatively flat desert terrain at 2,200 feet mean sea level (MSL). The eastern half contains the Argus Mountains, with canyons and washes that drain west into the flat G-1 area. Argus Peak is the highest point in the G-1 Range at 6,567 feet MSL. G-1 is the Center's most heavily instrumented range, with permanent cinetheodolites and M-45 tracking sites situated along G-1.

Test and evaluation of air-to-air, air-to-surface, and surface-to-air guided missiles. Some of the factors affecting missile systems that can be tested on G-1 Range are electronic and mechanical compatibility between the launch aircraft and the missile, seeker lock on ranges and tracking ability in the presence of countermeasures, validation of missile-control algorithms, and determination of warhead effectiveness using air or ground targets.

G-2 Range covers a 35-degree-wide, 37-mile long sector and shares its downrange area and instrumentation with the Guided Missile Range. The first 18,000 yards of G-2 are kept free of duds (normally only inert warheads are launched) so that debris from a weapon can be recovered for analysis. Instrumentation at the launch/fire position allows detailed study of launch characteristics and weapon ballistics.

Placed to fire to the north from the G-2 gunline are an 8-inch MK 16 gun; an 8-inch M1 gun; two 5"/54 guns, and two 3"/50 naval guns. This gun line has the capability for installation of mobile guns such as 105-mm, 155-mm, and 8-inch types. Fixed launch equipment includes a two-cell ASROC launcher and many other universal rocket launchers and launching pads. Facilities in the control area include a test-control building, an assembly and checkout building with temperature-conditioning chambers (-85 to +185°F) that handle weapons up to 20 feet long and 4 feet in diameter, and an ordnance paint booth.

G-6 Function: Test and evaluation of conventionally launched and vertically fired missiles, guns, and rockets where there is significant risk that the launched weapon or the target will impact in the launching or test control area. The site is located atop a mountain adjacent to the Guided Missile Range flight and missile corridor. The facility consists of a large concrete launch pad, several nearby instrumentation sites, and a semihardened underground test-control center.

The site is about 700 feet above the valley floor to permit low-altitude attacks of the site with missiles and remotely piloted vehicles (drones) without the use of the specialized control equipment required to fly missiles and drones at low altitudes. The low-altitude drone and missile flights can be performed for on-axis and off-axis headings. A natural impact area is located west of the site for safe deployment of ordnance and for drone debris.

Gun Target Range.

Functions: Firing projectiles from major caliber guns and firing ballistic and guided missiles to measure fuze sensitivity and fuze patterns and to determine how variation of the aspect of the target affects fuze performance. Firing of fuzed projectiles to collect data on burst heights and on fuze-burning performance. The focal point of range operations is the gun-line area where permanently mounted 3"/50, 5"/38, and 5"/54 naval guns and rocket launchers fire projectiles.

Vertical-Firing Range.

Function: Vertical firing of inert projectiles so that they will land tail-first in even-textured soil from which they can be easily recovered to study the effects of firing shock on the fuze mechanisms.

Small-Missile Range ("Redeye Range").

Functions: Tests of short range surface-to-air guided missiles against low-flying aerial targets. Field evaluations of small tactical air defense systems. Preflight tests of experimental air-to-air guided missiles and rockets. This range is used primarily for test activities entailing potential hazards from developmental ordnance of unproven reliability or from damaged, out-of-control target drones.

Large-Caliber Gun Range ("Tower 11").

Conducts dispersion tests of large-caliber gun projectiles including depleted uranium (DU) projectiles. The site is currently configured for 120-mm tank ammunition testing.

Small-Caliber Gun Range ("K-2 Range").

Functions: Study of the exterior ballistics of small-caliber projectiles from firing through impact. Although designed for testing 20 mm ammunition, the range can be used for other calibers, as well as for gun evaluations. This 1-kilometer-long firing range is instrumented with special camera systems for precise measurements of projectile velocity, structural integrity, stability, fuze functioning, internal and external ballistics, trajectory, and attitude.

Explosive Test Ranges provide testing of explosives (including rocket motors, warheads, and fuel-air explosive systems) using instrumented, isolated sites.

Propulsion Test Ranges. Capable of static tests of solid and liquid rocket motors and of air-breathing systems.

Facilities :

Supersonic Test Tracks are heavily instrumented and provide for tests requiring very high speeds, heavy carriages, long-duration runs, and controlled deceleration.

Live Ordnance Environmental Test Facilities. Test ordnance in all stockpile-to-target environments, such as vibration, shock, temperature, humidity, salt spray, and jet fuel fire.

The Electronic Warfare Threat Environment Simulation (EWTES). Facility provides enemy threat systems in a simulated electronic environment. Dedicated to the T&E of ECM systems and EW tactics development.

Aircraft Department. Provides aircraft and airfield facilities, as well as air support for RDT&E operations. Airfield facilities include three major runways (one 10,000 feet long), extensive aircraft maintenance facilities, 12 different types of aircraft, hangars, maintenance facilities, ordnance handling and storage facilities, and a boresight range. Services also include meteorological reports and forecasts.

Resources :

Specific range systems. Each range has the appropriate instrumentation and targets for the types of weapon systems tested, including:

Instrumentation.

Control Buildings	Metric Video
Voice Radio Links	Telemetry
FM VHF	M-45 Tracking Mounts
AM UHF	High-speed Fixed Cameras
Mobile Tracing Mount (for optical cameras)	IRIG Timing
	Cinetheodolites
Radar Laser Tracing	Video Impact Scoring

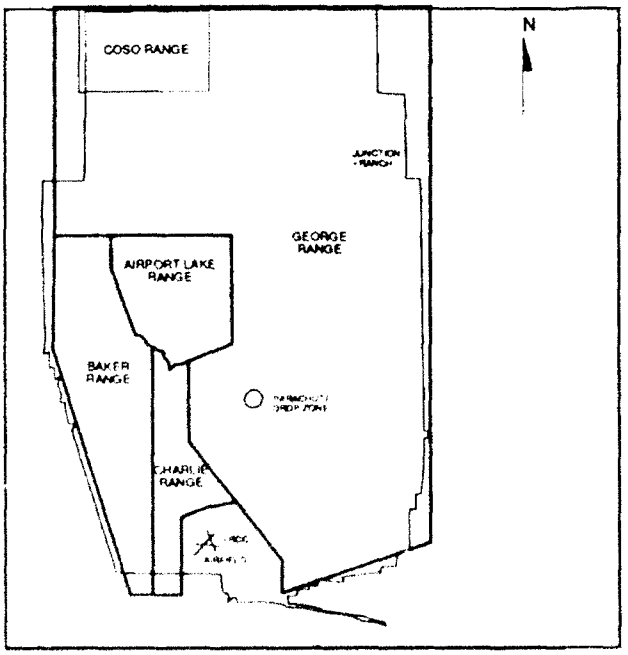
Major Instrumentation.

Trajectory Measurement Systems include nine digitized, high-accuracy radars, a fixed-line theodolite array of up to 40 locations supplemented with 6 mobile systems, 20 precision Bowen (synchro-ballistic) strip cameras, various metric video special purpose systems for impact scoring, and miss-distance applications.

Telemetry Systems include four fixed data acquisition stations replete with complete receiving, recording, demodulating, demultiplexing and display for all types of IRIG telemetry formats, and airborne video.

Special Optics provide a wide variety of specialized cameras, such as tracking cameras (with up to 200-inch focal length lenses) and fixed high-speed film and video cameras that support tests at all ranges and facilities. Other special optical systems include a mobile van for measuring laser spot characteristics and video systems for determining cluster weapon patterns and projectile fuzing.

Support Systems include ultra high frequency (UHF) and very high frequency (VHF), broad band cable, microwave communications, central IRIG timing, frequency monitoring, meteorological facilities, and a surveillance radar system for R-2508 Airspace.



Air Ranges and Parachute Drop Zone on the Naval Weapons Center North Ranges

Specific Range and Facility Systems include instrumentation unique to their individual functions. Examples are environment simulation and fuze targeting systems at the research track, dynamic X-ray capability for propulsion testing, and combined environmental conditioning for live ordnance tests. Full scale RPV (drones), Integrated Target Control system, and missile and drone flight termination systems support tactical missile testing.

Parachute Test Facilities include the NWC drop zone, the water and land drop zones, and the Whirl Tower at El Centro, California.

Targets

- Tank Park
- 120-mm Antiaircraft Battery
- Military Supply Dump
- Truck Convoy
- Two 260-foot Bailey Bridges
- Two tunnel entrances
- Revetted surface-to-air missile site
- Aerial (QF-4, QF-86, QH-50)
- Aircraft for tracking tests (as required)
- RF targets
- Fixed or moving ground targets
- Two 360-ft wooden towers can suspend targets as large as full-size aircraft up to 250 ft above the ground

TYPICAL PROJECTS SUPPORTED

- TRIDENT
- SKIPPER
- Aircrew Systems
- SPARROW
- F-16 INTEGRATION
- HARM
- CHAPARRAL
- POLARIS
- WALLEYE
- SIDEARM
- A-6 TRAM
- F/A-18
- HARPOON
- ROLAND
- Parachute Systems
- SIDEWINDER
- GATOR MINES
- All Navy Conventional Ordnance
- POSEIDON
- SEAWARS
- FAE-II
- ESCAPAC
- CRUISE MISSILES
- PHALANX
- A-7
- MAVERICK
- ARBS

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PACIFIC MISSILE TEST CENTER (PMTC)

MISSION

Perform development, test, evaluation, and follow-on engineering, logistics, and training support for naval weapons, weapon systems, and related devices; and provide major range, technical, and base support for Navy RDT&E users, the Fleet, and other DoD and government agencies.

LOCATION

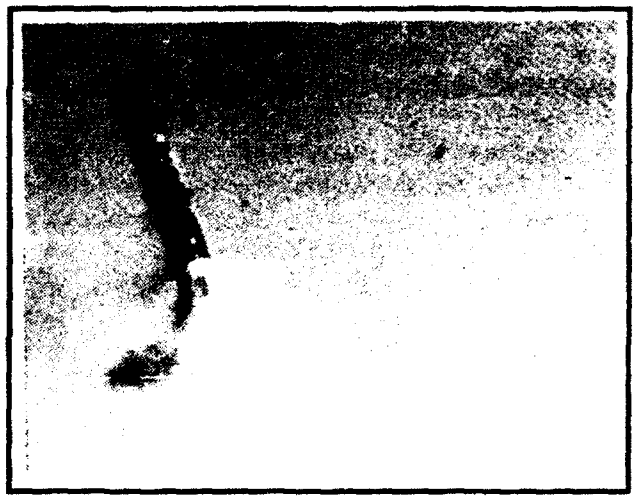
The Pacific Missile Test Center (PMTC) is located at Point Mugu, California, 60 miles northwest of Los Angeles, California, with a subordinate command, Pacific Missile Range Facility, located at Barking Sands, Kauai, Hawaii.

CAPABILITIES

Topography :

Sea Test Range. A 32,000-square mile, highly instrumented sea test range off the California coast for multiple air- or surface-launched missile live firings against multiple air or surface targets. Test aircraft and flight test planning and support are provided. The Extended Area Test System (EATS) provides a capability to extend the range capabilities of tracking (60 or more participants), telemetry (10), miss-distance (10), target control, and communications (15) 250 nautical miles or more seaward of San Nicolas Island from Baja, California, to Point Conception, augmenting land-based capabilities. EATS also provides telemetry and impact scoring in the broad ocean area (BOA). Mobile Sea Range capability provides tracking, telemetry, target control, and communications capability for Fleet training in the Pacific, Atlantic, and Mediterranean BOA.

Underwater Range. A 700-square mile, highly instrumented, three-dimensional underwater tracking range in over 10,000 square miles of sea test range in the Hawaiian area to support multiple air, surface, and submarine antiair warfare and antisubmarine warfare (ASW) weapons tests against multiple air, surface, or underwater targets. Ambient noise and data system for submarine as well as ship acoustic signature measurements are available.



Tomahawk Test Launching

Ranges :

Inland Range. Inland route for cruise missile testing, linking range systems at San Clemente, Point Mugu, Vandenberg Air Force Base (AFB), Edwards AFB, Naval Weapons Center, NASA, Utah Test and Training Range, and Ely, Nevada, using microwave systems and specially equipped aircraft accompanying the missile.

Facilities :

Reliability Test Labs. Production acceptance test and evaluation for ship- and aircraft-launched weapons systems is performed based on simulated mission profiles, using combined environmental tests with controlled temperature, humidity, rain, snow, salt fog, shock load, acceleration, sea-level to 150,000-foot altitude, and random and sinusoidal vibration capability for reliability and qualification tests. The all-up-round functional and environmental missile test capability is unique.

Hardware-in-the-Loop Simulation. Weapon system simulation laboratory provides analog and digital simulation of major weapons systems components with hardware-in-the-loop. System performance is evaluated in a hostile electronic countermeasures (ECM) environment involving actual missile components and computer simu-

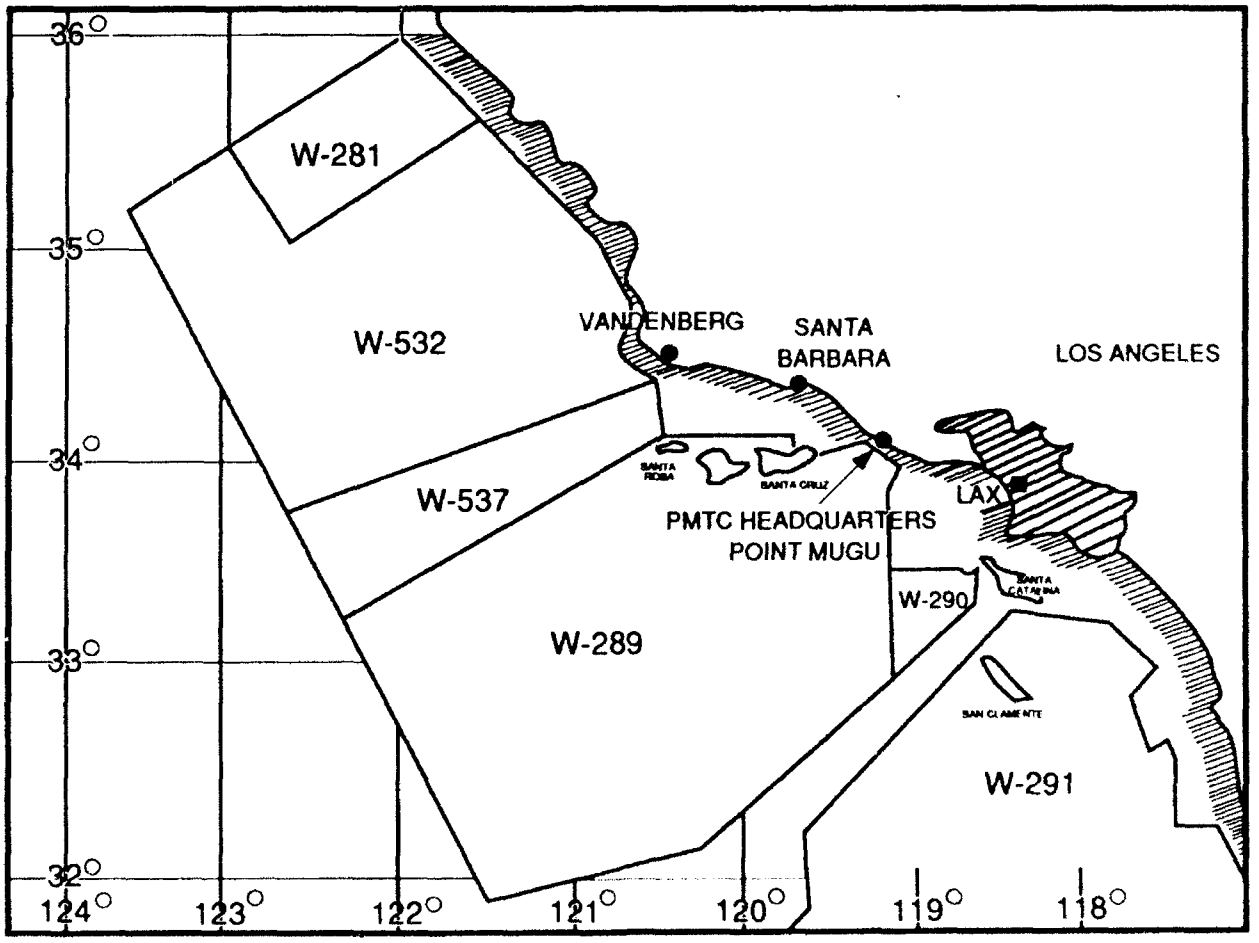
lated in-flight dynamics. These data are evaluated for end-game and force level effectiveness.

Software Support Activity. Tactical software support is provided to develop, evaluate, and maintain software for integrated tactical offensive and defensive airborne weapons and EW systems both under development and deployed. Environmental and performance software simulations and man-in-the-loop and avionics hardware simulations provide T&E of totally integrated hardware and software subsystems of platform avionics and weapon systems.

Electronic Warfare. EW laboratories, systems equipment, and aircraft test beds are available for development, test and evaluation, integration and support of radio frequency (RF), electro-optical (EO), and infrared (IR) warning receivers and countermeasure devices. Laboratories, airborne devices, and simulation equipment are available for the T&E of weapon systems in electromagnetic environments and development of counter-countermeasures.

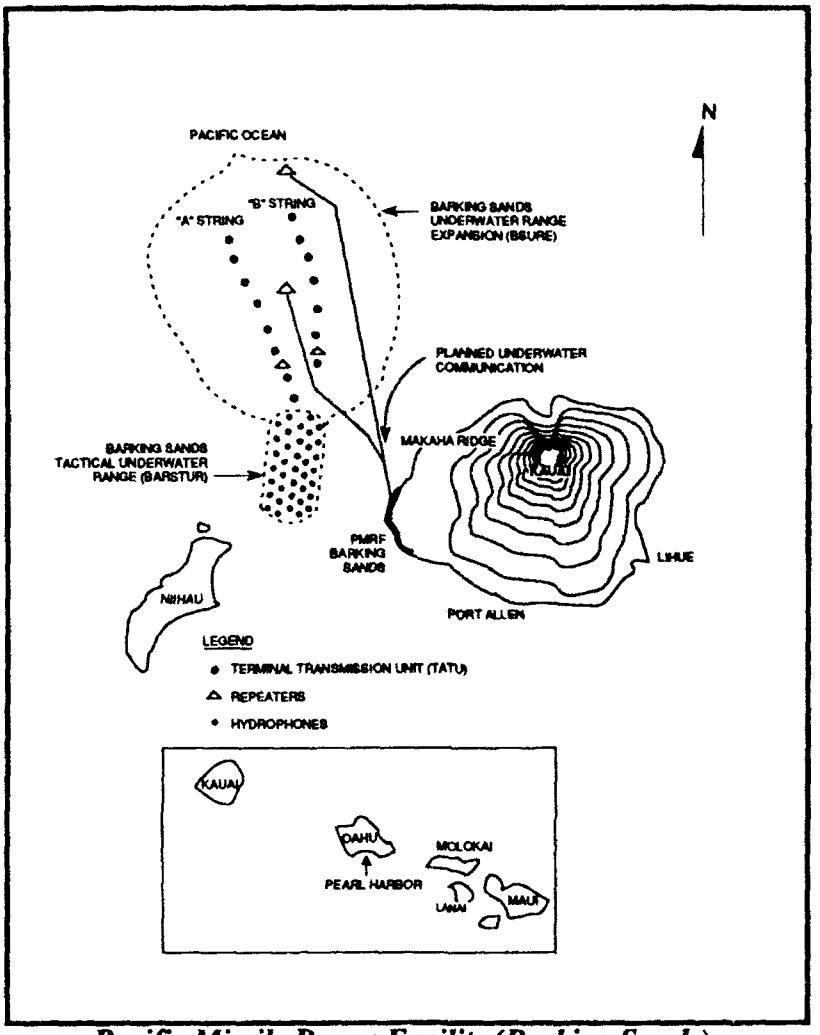
Anechoic and Acoustic Facilities Anechoic and acoustic facilities provide the capability for vulnerability and survivability evaluations of weapon systems in areas of radar reflectivity, electro-optic signature, and electromagnetic compatibility.

Microelectronics Laboratory Facilities for development, design, prototype fabrication, test and evaluation of weapons systems instrumentation for flight testing of missiles and aircraft.



Pacific Missile Test Center (Sea Test Range)

U.S.A.



Pacific Missile Range Facility (Barking Sands)

Resources :

Targets. Aerial targets available include QF-4, QF-86, AQM-37A, BQM-34 A/S and E/T, BQM/MQM-74C, MQM-8G, and airborne tow targets. Surface targets available include SEPTAR MK-33/35, TRIMARAN, and ex-DD/DE hulk pontoon barge. Infrared and radar augmentation are developed and provided.

TYPICAL PROJECTS SUPPORTED

EA-6B and EW Software Support Activity
F-14 Weapons Systems Integration
F-18/Missile Integration
MINUTEMAN
Cruise Missiles, TOMAHAWK/ ALCM/GLCM
Space Shuttle
Space Projects
HARPOON/MRASM
Airborne Self Protection Jammer (ASPJ) HARM
Fleet Training/Tactics Development for Air/ASW Surface and Underwater Systems PHOENIX/AIAAM AEGIS/SM-1/SM-2 OPEVAL Support (VX-4) TRIDENT
Peacekeeper

POINT OF CONTACT

Pacific Missile Test Center
Point Mugu, CA 93042
Code: 0120

Telephone:
AUTOVON: 351-8741
Commercial: (805) 982-8741

AERONAUTICAL SYSTEMS DIVISION 4950TH TEST WING

MISSION

Perform flight test of military systems, subsystems, and components; operate and maintain a fleet of test support aircraft; provide flight test engineering, Class II aircraft modification design and installation, and technical photographic and data acquisition services for R&D flight tests; manage AFSC Class II aircraft modification policy; and operate the Advanced Range Instrumentation Aircraft (ARIA) in support of other ranges and special missions on a worldwide basis.

C-130

LOCATION

The 4950th Test Wing is located on Wright-Patterson AFB, near Dayton, Ohio.

CAPABILITIES

The 4950th Test Wing has the capability to plan, conduct, evaluate, and report on R&D flight tests of military systems, subsystems, and components. This includes the capability to design, install, and operate all types of airborne instrumentation.

The 4950th Test Wing also has the capability to design, procure, fabricate, and install Class II aircraft modifications. Special areas of expertise and experience include aircraft electrical systems, structures (including radomes), pneumatics, and avionics. Sophisticated equipment is available for nondestructive inspections, wind-tunnel model measurement, metal dimensions, contour measurement, and advanced computer-aided design and manufacturing capability.

Technical photographic support for all AFSC organizations at Wright-Paterson AFB and other R&D projects is provided.

Maintains an inventory of aircraft, including C-135s, C-141s, C-130s, C-18s, T-37s and T-39s, and other specially modified aircraft to support specific types of flight tests, such as electronics countermeasures, identification friend or foe, airborne lasers, and inertial navigation systems. Flight tests are conducted at Wright-Patterson AFB, Edwards AFB, Eglin AFB, Kirtland AFB, and other worldwide locations.

Flight Test Range airspace is available near Wright-Patterson AFB. The 4950th Test Wing operates range instrumentation systems at Wright-Patterson AFB including M-33 tracking radar and a precision approach area tracking system (laser system with a range of 15 miles).

The ARIA fleet consists of dedicated special-purpose C-18 and C-135 aircraft modified to serve as airborne telemetry terminals. The aircraft are deployed on a global basis to cover launch activity at either Eastern Space and Missile Center or Western Space and Missile Center. The ARIA provides acquisition, tracking, recording, retransmission of telemetry signals, and voice relay of transmissions from spacecraft, aircraft, and ground stations.

TYPICAL PROJECTS SUPPORTED

Flight testing in support of electronic warfare, electro-optics weapons, and navigation and communication testing, including ASC 30 Satellite Communications, Extra High Frequency Electronic Warfare Systems, NAVSTAR Global Positioning System, and Aerial Refueling Systems.

Air worthiness testing of modified aircraft including Sabre Cross and IARS Hose Reel.

ARIA support to ESMC (Trident, Titan III, Pershing II, Chevaline, and Poseidon); WSMC (Space Programs A/B/C/

D, Defense Met Satellite Program, and Global Positioning System); and Cruise Missile Programs (Air Launch Cruise Missile and Ground Launch Cruise Missile). Also support to NASA including Special Interest Launches (SILs), INTELSAT V-C/V-D/V-E, INSTAT - 1A and Peacekeeper Program.

Airborne Laser Laboratory (ALL) - Det 2, Kirtland AFB, NM

Central Inertial Guidance Test Facility (CIGTF) Support - Holloman AFB, NM

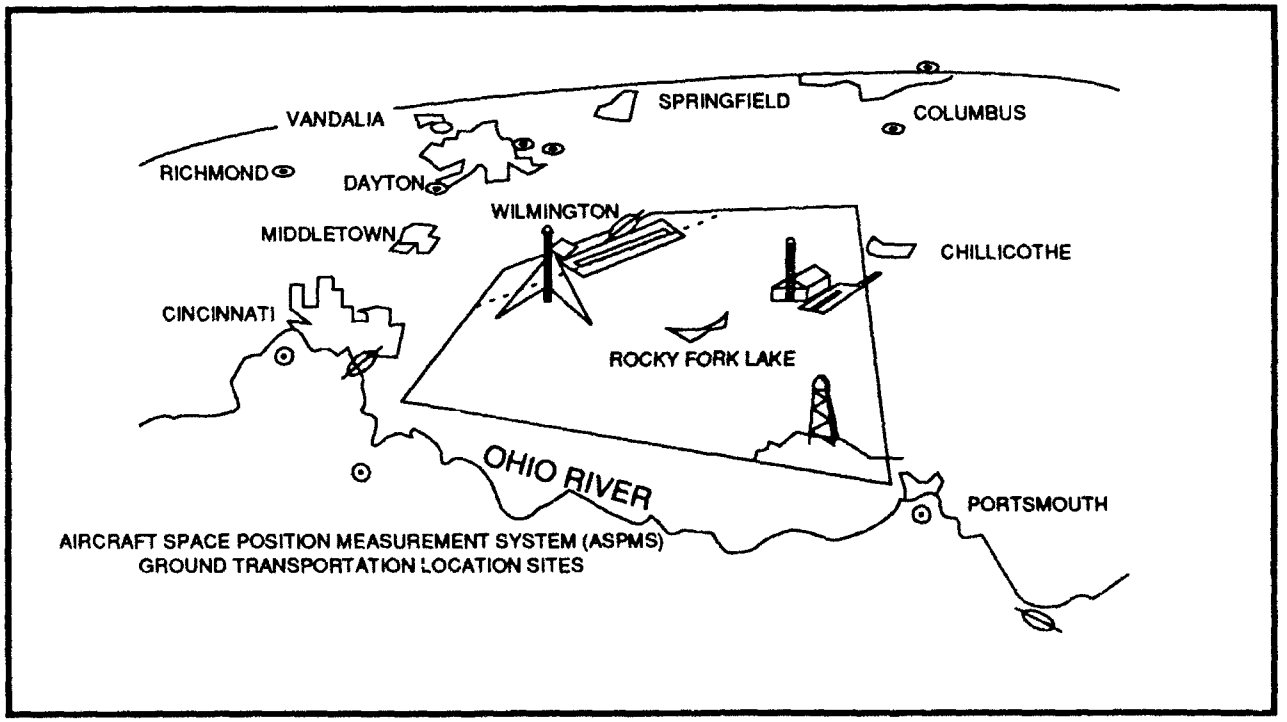
Air Force Geophysics Laboratory (AFGL) Support - Wright-Patterson AFB,OH

Speckled Trout - Det 1, Andrews AFB, MD

POINT OF CONTACT

4950th TW/RM
Wright-Patterson AFB, OH 45433

Telephone: AUTOVON: 787-2278
Commercial: (513) 257-2278



4950th Test Wing Restricted Area

ARMAMENT DIVISION 3246TH TEST GROUP

MISSION

Provide the DT&E of nonnuclear air armament for the Air Force. This includes air-launch tactical and air defense missiles, guided weapons, nonnuclear munitions, aircraft guns and ammunition, and aerial targets and T&E of Electronic Combat (EC) systems and climatic simulation. Provide support for operational training, OT&E of armament and EC systems, and other activities conducted by operational commands.

LOCATION

Eglin Air Force Base, Florida.

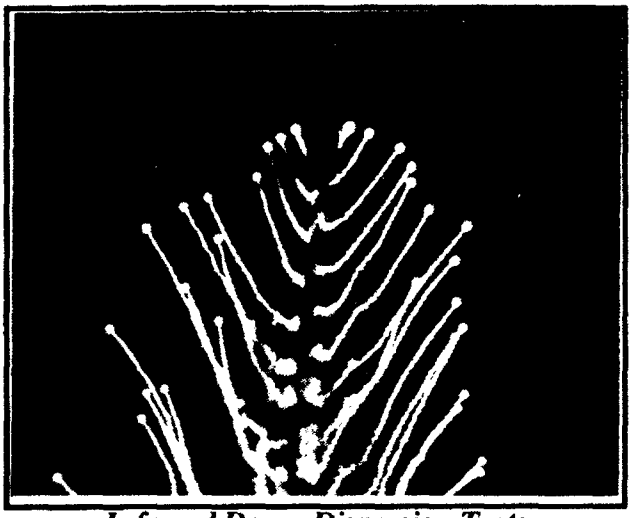
CAPABILITIES

Topgraphy : The Eglin land range covers 724 sq miles and the water test range (98,000 sq miles) covers most of the Gulf of Mexico.

Ranges :

The Armament Systems Test Environment (ASTE) consists of varied multienvironmental land test areas, instrumentation and airborne capability needed for air armament DT&E and OT&E. Twenty-seven highly instrumented land test areas are dedicated to air-to-surface testing. Low- and high-altitude and supersonic flight profiles can be accommodated. Included are static arenas for warhead and lethality evaluations, aircraft gun test areas, 2000-foot dual-rail sled track, and numerous air-to-air, air-to-surface, and surface-to-air test areas.

The Electromagnetic Test Environment (EMTE) is a highly instrumented simulated hostile defense system consisting of tracking, search, and height-finder radars operating in different frequency bands and modes. The complex system can separately or simultaneously support noise and deception jammer evaluations, dynamic chaff and aircraft reflectivity measurements, RF and optical countermeasures evaluations, dynamic antenna pattern measurements, and tactics evaluation.



Infrared Decoy Dispersion Tests

Water Test Areas are used extensively for air-launched munitions test and training and as a maneuvering area for EC missions.

Facilities:

Simulation Facilities are available to support a broad spectrum of T&E. Environmental testing of entire aircraft systems as large as the C-5 aircraft can be accommodated in the free world's largest climatic facility. Military standard environmental testing capabilities are available in the Fuze Test Facility to support small subsystems and component testing. New technology guided weapons seekers and countermeasure techniques are tested in the Seeker Evaluation Test Simulation Facility.

Base and Installation Security Systems encompass 752 acres and are dedicated to the evaluation of security systems against typical threat scenarios approximating actual operational conditions.

Seeker Evaluation Instrumentation Systems provide radiometric, spatial, and spectral measurements of background and target signatures in ground and airborne scenarios for the visible through IR and millimeter wave portions of the electromagnetic spectrum. The capability also exists to test weapon seekers in a captive "real world" situation.

U.S.A.

Central Control Facility (CCF) provides test managers real-time mission analysis and the capability to control their missions from the Eglin Main Base. The multipurpose computers supporting the CCF have access to most range resources (radars, telemetry, and airborne units) and allow conduct of up to four missions from the CCF simultaneously.

Range Engineering Personnel provide the in-house engineering capability to rapidly modify existing facilities or acquire additional unique test capabilities in order to tailor the range to meet unique project requirements.

Resources :

Multiple-Purpose Resources (MPRs) include tracking radars, phototheodolites, communications, frequency control and analysis, telemetry, command guidance and destruct, real-time data, and range safety control capabilities. The MPRs are used in conjunction with the ASTE and EMTE.

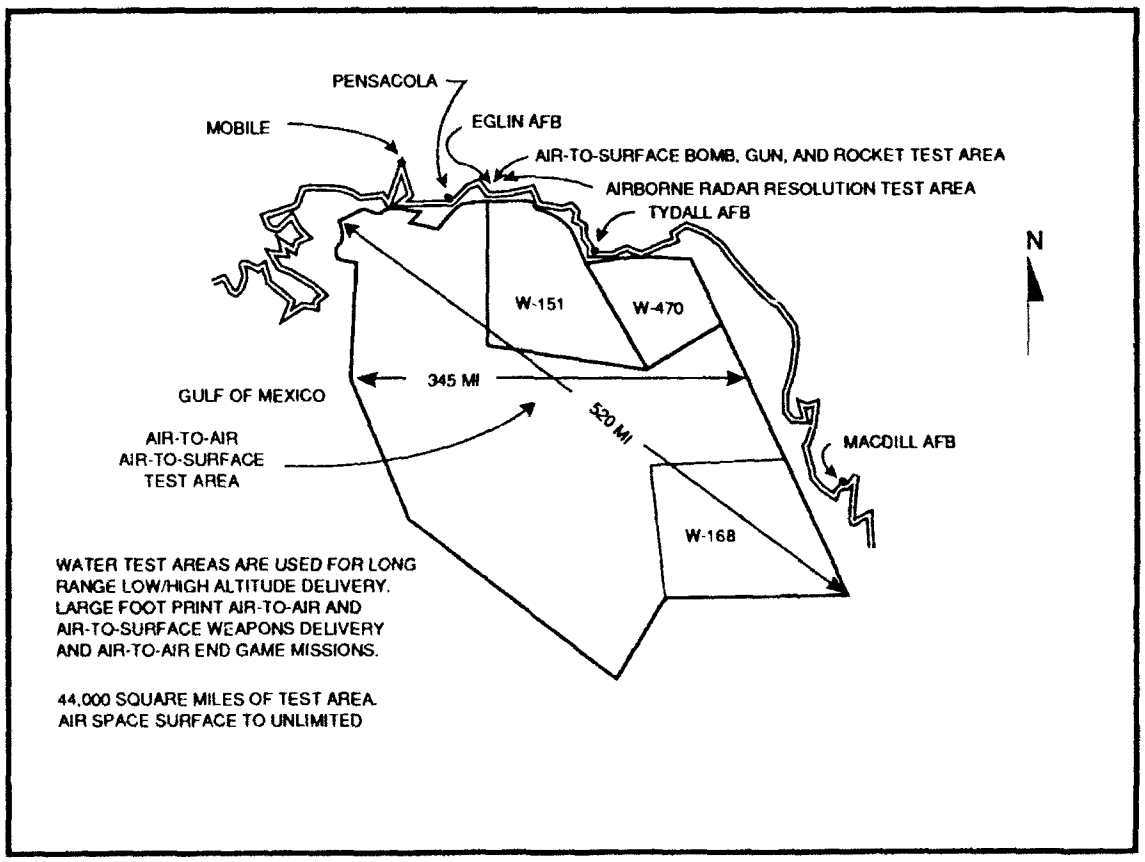
TYPICAL PROJECTS SUPPORTED

Ordnance and Munitions
Target Acquisition
Warhead Performance
Electronic System
Fuzing Sensors - EO, Laser, IR Millimeter Wave
Terminal Effects Electromagnetic Warfare
Aerodynamics Base Installation Security System
Ballistics Climatic Simulation
Aircraft Compatibility
Guided Weapons
Air-to-Air
Air-to-Surface

POINT OF CONTACT

AD/XP
Eglin AFB, FL 32542

Telephone: AUTOVON: 872-3488
Commercial: (904) 882-3488



Eglin Water Test Areas

ARMAMENT DIVISION 6585TH TEST GROUP

MISSION

Provide test and evaluation of aerospace navigation and guidance systems and components, simulation of dynamic flight conditions using the high-speed test track, radar antenna pattern and cross-section measurements, and operational and maintenance support of Air Force Systems Command (AFSC) test aircraft staging out of Holloman AFB. The Test Group is the DoD focal point for verification testing of aircraft inertial navigation systems. It is the sponsor for Air Force users of the White Sands Missile Range (WSMR), controls all WSMR airspace, and provides liaison for the WSMR in all FAA matters.

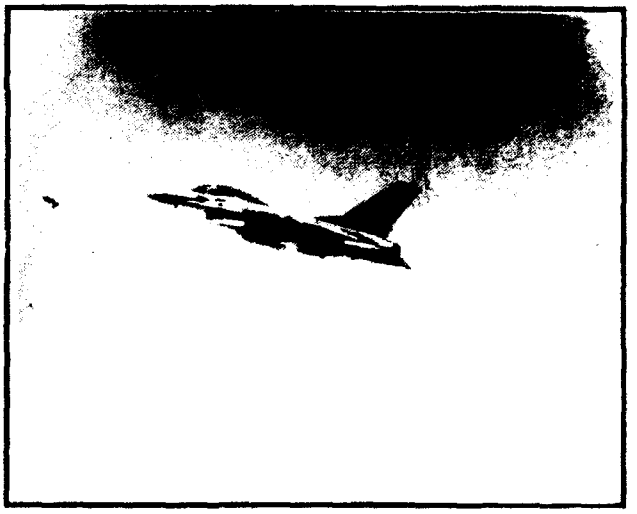
LOCATION

The 6585th Test Group is located at Holloman AFB, Alamogordo, New Mexico.

CAPABILITIES

This Test Group is a multiple-discipline organization that accomplishes the necessary DT&E of aerospace guidance and navigation systems and components using laboratory, aircraft, and sled test facilities; provides realistic flight conditions and recovery of the test item; subscale and full-scale radar backscatter measurements of various types of vehicles, systems, and components; provides chase aircraft and photography of AFSC project aircraft conducting tests on the WSMR; and the development of the necessary facilities, capabilities, and modern test technology to support the assigned programs, including instrumentation, analysis, and data processing.

The Guidance Test Division operates the Central Inertial Guidance Test Facility (CIGTF) and provides test, evaluation, and analysis of components and systems applicable to missile guidance and aircraft navigation. The CIGTF, located in a seismically quiet area, provides an environment that is essential for testing to the accuracy levels required for high accuracy guidance systems. The CIGTF can test hardware to 100 gs on a precision 260-inch radius centrifuge arm. A combined environmental test chamber can provide a service environment by programming and simultaneous application of altitude (pressure), temperature, humidity, and vibration. Gyro and accelerometer test tables at the CIGTF provide position accuracy of 0.36 arc seconds. A completely integrated reference instrumentation system (CIRIS) is available as a spatial reference to test aircraft navigation systems. The accuracies of CIRIS are 13 feet in position, 0.1 feet/second in velocity, and 5 arc minutes in attitude. Project 688G, Aircraft Navigation System Verification, provides flight test verification of new developments of aircraft inertial navigators before selection into the DoD inventory. Up to six new navigation systems are verified each year.

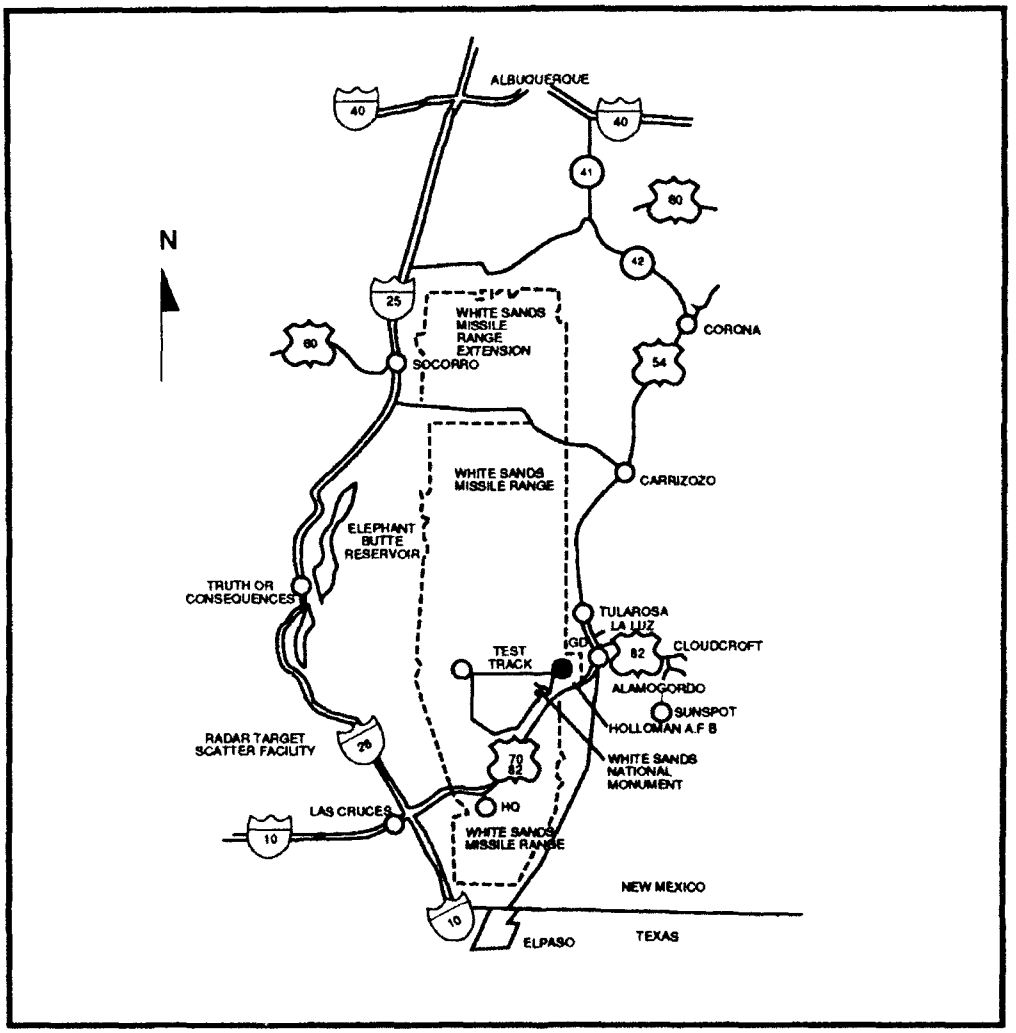


Air to Air Missile

The Test Track Division operates and maintains the high-speed test track. This aerospace ground test facility has capabilities for dynamic testing of crew escape systems; aerodynamic decelerators; rain, dust, and particle erosion; guidance and aeropropulsion systems; for impact testing, hypersonic and transonic aerodynamic testing at high Reynolds numbers, dispenser system testing, and explosive blast testing; and for launch into free flight. This track is the longest (50,788 feet), most precisely aligned, and most highly instrumented of its kind. The master rail is aligned within .005 inch with respect to a reference (fiducial) line established with better than first-order accuracy over its nearly 10-mile length. A precision space time system provides a velocity reference better than 0.01 feet/second. Speeds up to 3,200 feet/second have been demonstrated. Depending upon the payload size, accelerations above 200 gs have been demonstrated, and sled weights range from 100 to 30,000 pounds.

The Radar Target Backscatter Facility (RATSCAT) Division provides full-scale and subscale radar cross-section measurements of rockets, missiles, reentry vehicles (warheads and decoys), aircraft, aircraft weapons, bombs, radar absorber materials, aerospace vehicles, chaff and debris, rocket plumes, trucks, and other aerospace and ground-based objects. The RATSCAT facility is isolated physically and electromagnetically by its location in the alkali flats area of the WSMR. The facility and its location permit precise, controlled, and repeatable radar cross-section measurements. Two 140-foot towers and a 200-foot tower provide look-down measurement capabilities. Bistatic measurements up to 160 degrees can be performed. A large target rotator is capable of supporting full-size aircraft and large missiles. The test radars dynamic range is 70 decibels and targets as small as 0.0001 square meters may be measured at frequencies up to and including 13 GHz. A model-making facility is an integral part of the RATSCAT capability.

The Aeronautical Test Division provides operational and maintenance support for AFSC flight test aircraft staging out of Holoman AFB. Support of other DoD flight test requirements is available. Cargo and transport testbed aircraft that are required to support the CIGTF for evaluation of navigation systems are provided by the 4950th Test Wing at Wright-Patterson AFB, Ohio. Fighter aircraft from the Armament Division, Eglin AFB, are operated and maintained by the Aeronautical Test Division and staged out of Holloman AFB in support of CIGTF test and missile devel-



6585th Test Group Holloman Air Force Base

opment tests conducted on the WSMR. The Division also provides WSMR scheduling, a flight-planning facility, life-support equipment services, aircrew briefings, aerial photographic support, a government flight representative, and liaison for transient testers.

The Deputy for the Air Force/WSMR serves as sponsor for all Air Force programs testing on the range.

TYPICAL PROJECTS SUPPORTED

Peacekeeper and Trident missile guidance systems and components; 688G project aircraft inertial navigation systems including Standard INS; B-52 OAS./IWS; Space Telescope Gyros; B-1B avionics; Peacekeeper missile guidance launch simulation; HBU-X lap belt; M739 P.D. fuze; MK-82 bunker target munition; QF-100 antenna and cross-section testing; PQM-102; B-1 114 scale model; Firebee drone; HAVE RUST; AMRAAM; PAVEMOVER; AIM-9P; and ACES-II ejection system.

POINT OF CONTACT

6586th Test Group/PXR
Holloman AFB, NM 88330

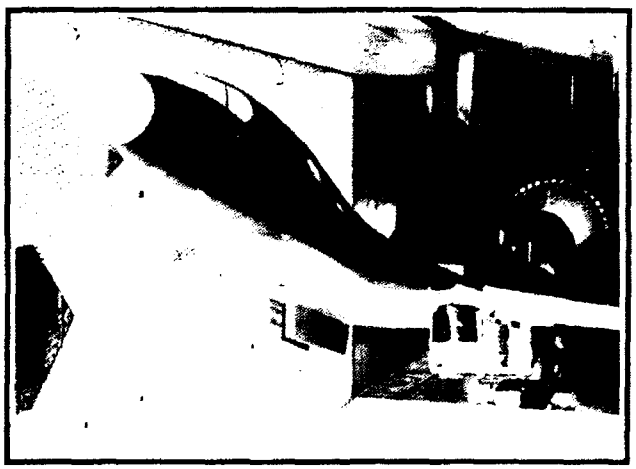
Telephone:
AUTOVON: 867-4366
Commercial: (505) 479-4366

U.S.A.

ARNOLD ENGINEERING DEVELOPMENT CENTER (AEDC)

MISSION

Manage, develop and operate ground environmental test facilities in support of R&D of aerospace systems. Perform research and apply new technology for developing advanced test facilities, test techniques, and measurement methodologies associated with simulation of aerodynamic, propulsion, and space flight environments. The Arnold Engineering Development Center (AEDC) supports a broad range of government and commercial users.



B1 Model in Wind Tunnel

LOCATION

The AEDC is located in the middle of Tennessee, 72 miles southeast of Nashville and 61 miles northwest of Chattanooga. The AEDC facility complex (4,000 acres) is located within a 40,000-acre reservation. The isolated location makes it possible, with a minimal environmental impact, to accommodate the next generation of test facilities within its test disciplines.

CAPABILITIES

Ranges:

Aeroballistic and Impact Ranges. Four ranges are available, including the 1000-foot Range G complex capable of accelerating models to 23,500 ft/sec at simulated altitudes up to 244,000 feet. The range has a track system to capture and recover the models. The capabilities also include simulating snow, ice, rain, and dust with controlled size and density. Also included is a bird impact range used to investigate the effects of bird strikes on aircraft parts.

Facilities:

Wind Tunnels. The nine tunnels range in size from test sections of 1 square foot to 256 square feet and provide coverage over a Mach number range from 0.2 to 10. They are capable of providing performance, stability and control, store separation, heat transfer, ablation, and aeroelastic and loads data. The 16-foot tunnels are unique to this country because they are the only transonic and supersonic wind tunnels where airframe and propulsion integration testing can be done under controlled altitude conditions. The 4-foot transonic and 40-inch and 50-inch supersonic and hypersonic tunnels provide a continuous flow capability and have the most advanced captive trajectory systems available.

Arc Heater Test Units. Three facilities are included in this group. The dust Erosion Tunnel is equipped for injecting dust of varying size and density into the airflow. The High Enthalpy Ablation Test Facility uses a segmented arc heater capable of a 40-60 megawatt output for several minutes. The air system can provide air up to 270 atmospheres and flow rates up to 90 pound-meters/sec. Primary use of these erosion and ablation facilities is the analysis and evaluation of advanced materials.

Turbojet or Turbofan Test Cells. Six test cells are available for testing engines from 500 to 70,000 pounds of thrust, from sea level to altitudes of 120,000 feet with true temperature air flows up to Mach 3.3. Icing capability is also available. Engine test capabilities were enhanced significantly with completion of the Aeropropulsion systems Test Facility in fiscal year 1985.

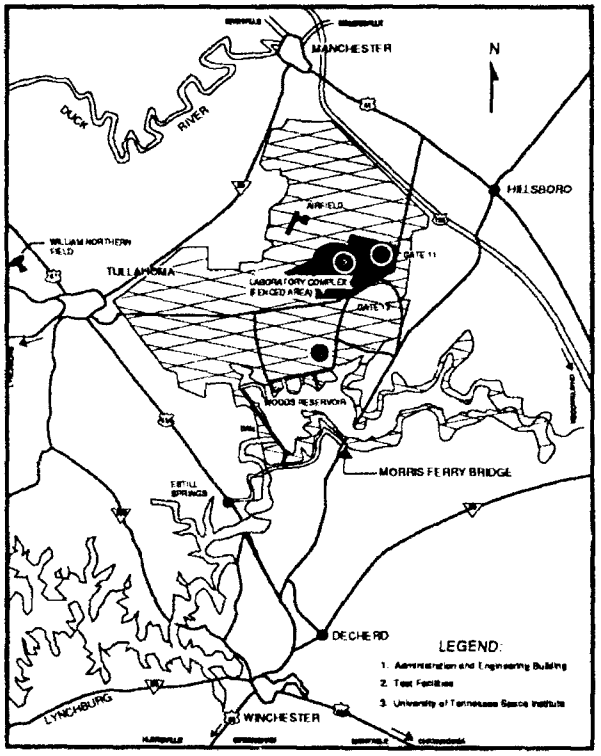
Ramjet Test Cell. This facility provides true temperature air up to Mach 5.6 (hypersonic). Within the performance map of the facility, free jet nozzles with diameters ranging from 18 to 72 inches can be accommodated.

Rocket Test Cells. Five test cells are available for testing both small and large rockets under altitude conditions up to 170,000 feet, from initial firing to thrust termination. It is possible to test liquid rockets up to a million pounds of thrust and solid rockets up to 300,000 pounds of thrust. One cell is specially equipped for testing rocket motors and engines in ultra high altitude (simulating space) conditions.

Space Chambers. Four chambers are available for highly specialized tests including infrared, aerodynamic, space propulsion, solar simulation, and thermal balance. The Mark I is 42 feet in diameter and 82 feet high. The size of the chamber permits testing of all Air Force space systems in a space environment (temperature, pressure, and solar simulation). The chamber size also makes it suitable for zero g testing and rocket plume signature studies.

TYPICAL PROJECTS SUPPORTED

B-1 and F-15/6
Air-Launched Cruise Missile
Vacuum Testing
Global Position Satellite
Full-Scale Satellite Thermal
Peacekeeper
Minuteman



Headquarters
Arnold Engineering Development Center
(Arnold Air Force Station, Tennessee)

Heads Up Display

U.S.A.

AIR FORCE FLIGHT TEST CENTER (AFFTC)

MISSION

Plan, accomplish, and report on Air Force development, test, and evaluation (DT&E) of manned and unmanned aircraft systems; participate in and report on test of operational flight simulator trainers; support and participate in Air Force initial operational test and evaluation (IOT&E) and follow-on tests of manned aircraft systems; test manned experimental and research aerospace vehicles; test parachute systems and aerodynamic deceleration devices; operate the USAF Test Pilot School; conduct or support artificial icing tests for the Air Force and other government agencies; develop, control, and operate test facilities used to support flight testing; and support operational funcitons, such as the Air Force Rocket Propulsion Laboratory, the NASA Hugh L. Dryden Flight Research Center, and the Army Aviation Engineering Flight Activity.

LOCATION

The Air Force Flight Test Center (AFFTC) is located at Edwards AFB, about 100 miles northeast of Los Angeles, on the western edge of the Mojave Desert.

CAPABILITIES

Topography

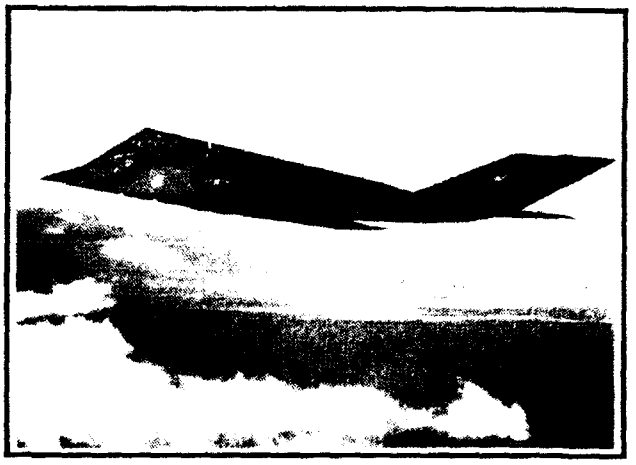
Surface

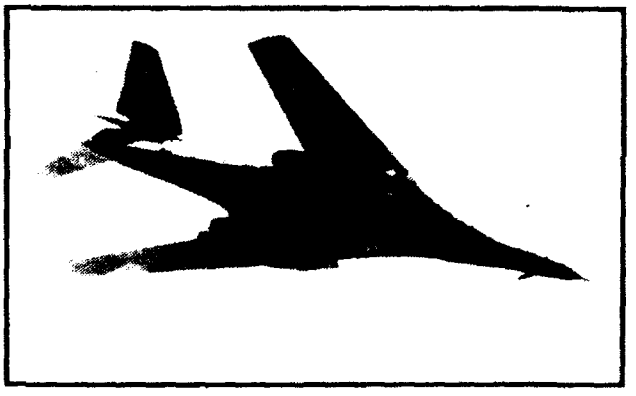
The AFFTC has 65 square miles of usable landing area on base with runway lengths up to 7.5 miles. Numerous dry lakebeds suitable for emergency landing exist throughout the southwest test range area to the Utah Test and Training Range.

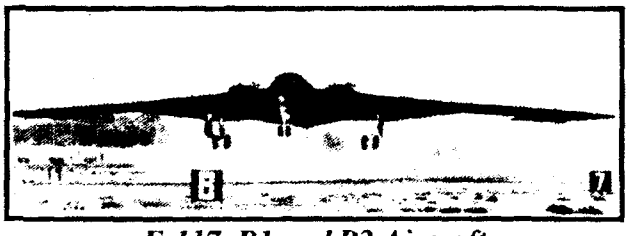
Nineteen aircraft hangar complexes, three with two hangar bays, include office space for engineering and administrative personnel, shop, and laboratory spaces. Thirteen hangars are located on the main base, four at the north base (ideal for classified programs), and two at the south base.

Airspace

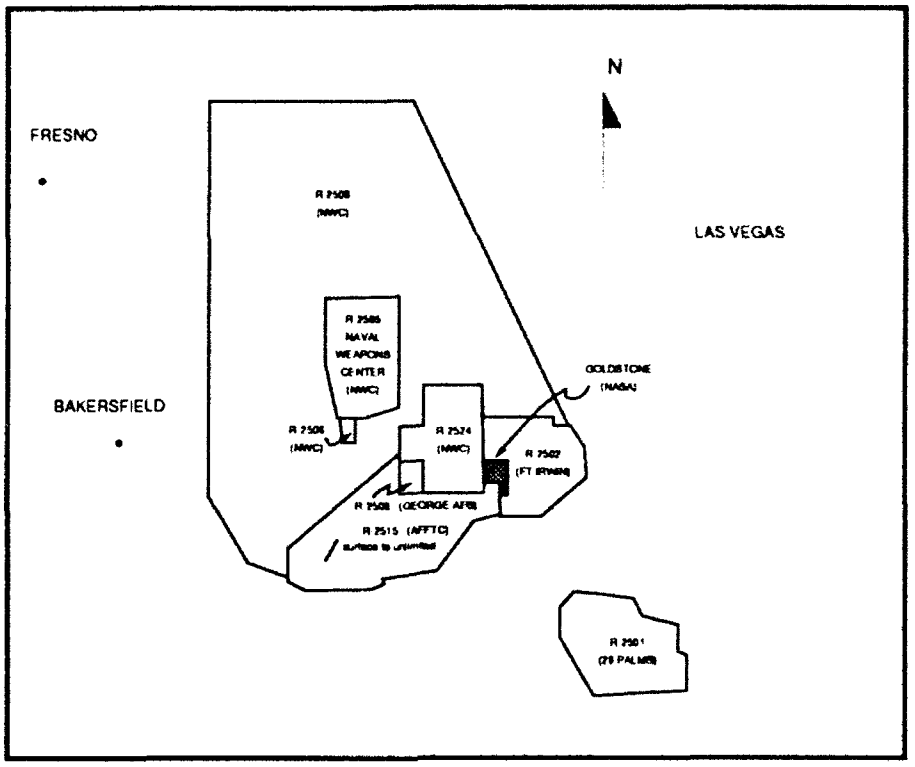
R-2508 California Restricted Area complex (12,000 to unlimited) with military operating area and forward air traffic control assigned airspace area extends approximately 130 nautical miles north, 30 nautical miles east, and 40 nautical miles west of Edwards AFB. Jointly managed by AFFTC, Naval Weapons Center, George AFB, and Army National Training Center. Radar approach control netted to all above mission control centers. Air traffic control exists (surface to unlimited) throughout most of R-2508 complex. Data links interconnect airspace and technical capability at Naval Weapons Center, Pacific Missile Test Center, and Western Space and Missile Center.







F-117, B1 and B2 Aircraft



Air Force Flight Test Center (Restricted Air Space)

Ranges :

Take-Off and Landing Facility. Uninterrupted photographic time-space-positioning data on a 300-foot wide by 15,000-foot long main runway, with transition to Rogers Dry Lake.

Low, Medium, and High Altitude Supersonic Corridors.

Four Aircraft Spin Areas (two instrumented), from 10,000 feet mean sea level to unlimited altitude.

Precision Impact Range Area (PIRA). Includes dual air-to-ground gunnery range used for precision bombing, rocket firing, stores separation, evaluation of photo and infrared reconsystems, and other tests requiring precision ground instrumentation. The alpha corridor provides supersonic airborne entry into the PIRA.

Photo and Infrared Resolution Range. Targets include 18 bar type, one tridensity, five circle, one oblique, 14 check-cross patterns, and an infrared tactical range with a variety of surveyed targets.

Radar Fidelity and Geometric Range (RADFAG) Various reflector arrays and wide assortment of corner reflectors for forward and side-looking radar.

Facilities :

Mission Control Complex. Main AFFTC scientific data processing and display complex that monitors flight test missions in real time.

Data Acquisition and Reduction Facilities. Instrumentation engineering, range facilities, airborne and ground photography, television and various specialized range instrumentation, and large-scale digital computers are available.

Integration Facility for Avionics Systems Testing. Reliable means of testing, identifying problem areas, and improving integrated avionics systems concurrently with flight test programs.

Flight Test Simulation Facility Simulation capability using digital computers, cockpits, and six degree-of-freedom motion base.

Additional facilities available to support flight testing include Runway Meteorological System, Weight and Balance Facility, Flutter and Ground Vibration Systems, and a Subsonic Airspeed Calibration Facility.

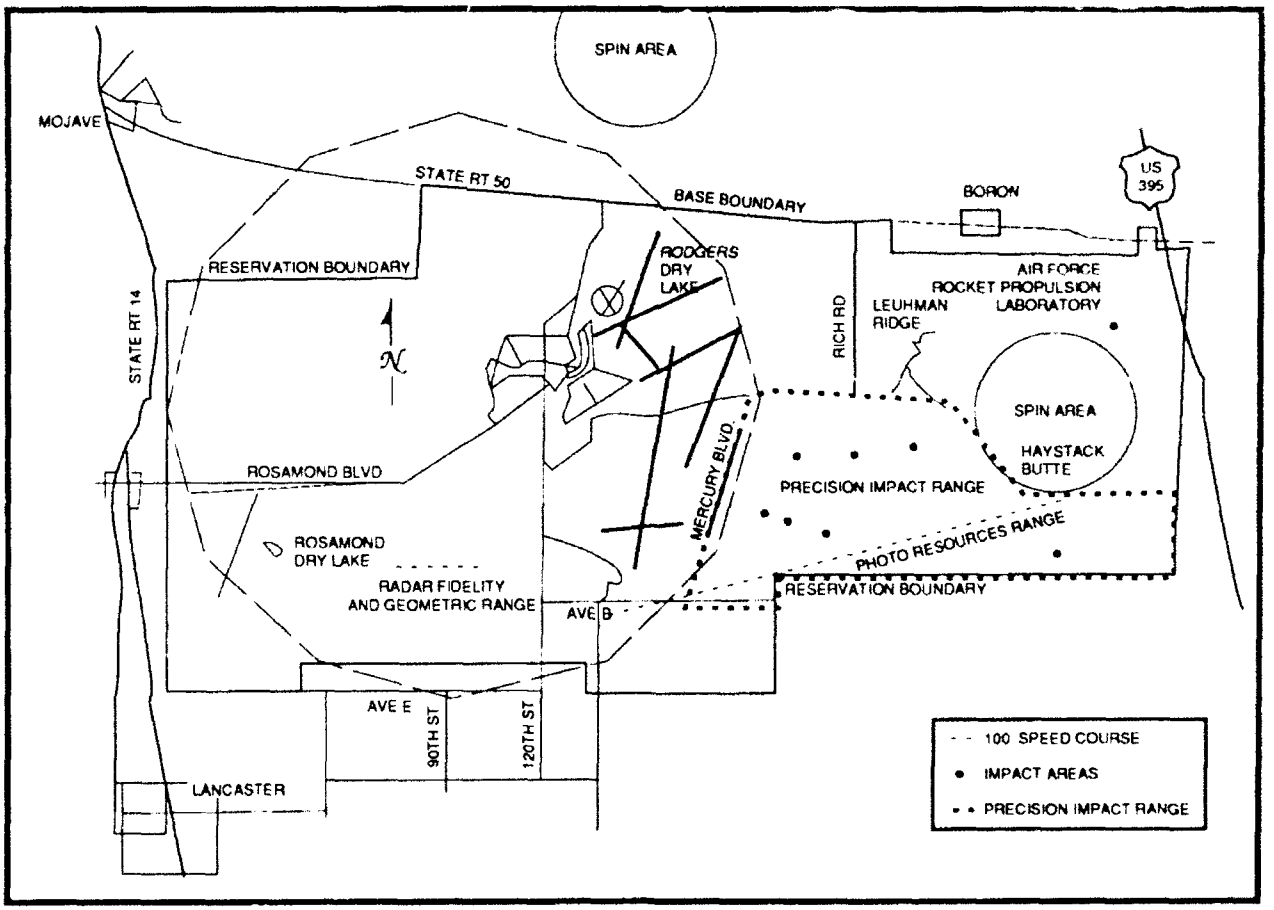
TYPICAL PROJECTS SUPPORTED

Flying qualities, performance, flutter, air loads, avionics, and other flight tests (F-15, F-16, F-5, ALCM, B-52, Airborne Warning and Control system, and B-1).
Aerodynamic decelerator testing. USAF Test Pilot School.
Runway arresting gear test compatibility with Air Force aircraft.

POINT OF CONTACT

AFFTC/XR
Edwards AFB, CA 93523

Telephone:
AUTOVON: 350-3837
Commercial: (805) 277-3837



Air Force Flight Test Center Edwards Air Force Base, Ca.

EASTERN SPACE AND MISSILE CENTER (ESMC)

MISSION

Manage and operate the Eastern Test Range (ETR). The mission consists of support for launching and testing of missile and space systems from Cape Canaveral Air Force Station (CCAFS) and other launch locations; support of the Space Transportation System launches from Kennedy Space Center (KSC); the operation of an instrumentation ship; support of tenant activities at CCAFS and downrange stations; and support of special projects and R&D tests. Inherent in the ESMC mission is the responsibility for planning, ground and flight safety, engineering, support services, and scheduling of test operations including launch and downrange support.

LOCATION

ESMC Headquarters is located at Patrick AFB (PAFB), Florida, on the central east coast of Florida.

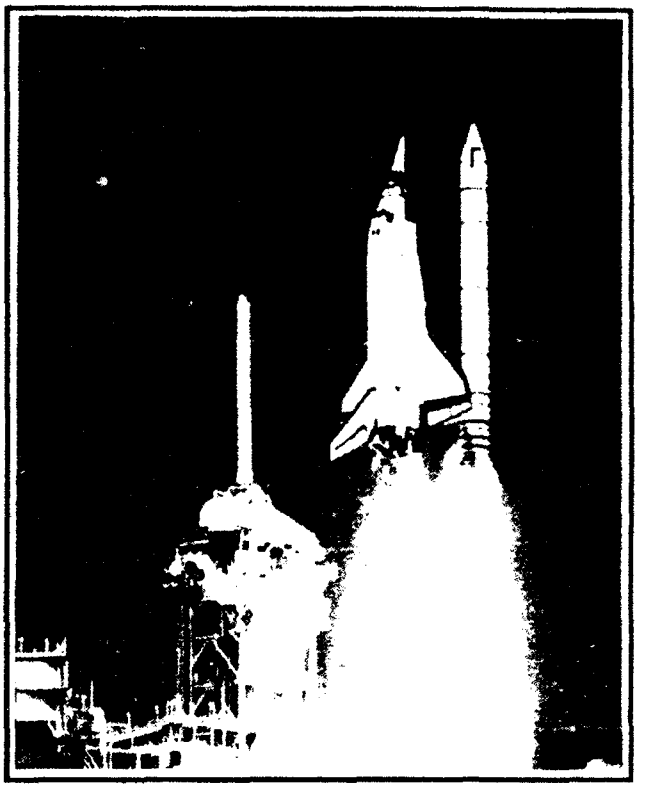
CAPABILITIES

Topography :

Patrick AFB is an integral part of ESMC and is the technical and logistics center for ESMC. PAFB encompasses 2,108 acres of land with a primary runway (9,000 ft.) instrumented to handle all types of military aircraft. PAFB is also the location for an Air Force hospital, which supports DoD Service members. Located at PAFB as tenants are Air Force Technical Application Center (AFTAC), 549th Tactical Air Support Training Group, 2179th Communications Group, 2nd Combat Communications Group, Defense Equal Opportunity Management Institute, and the Army Readiness Group.

Ranges :

Mainland and downrange stations are located in a chain of sites extending to South Africa, providing launch, midcourse, and terminal coverage for ballistic missiles. A station network provides space launch coverage for low-earth and synchronous orbits and for space operations and orbital tracking of active and passive satellites.



Space Shuttle Launch

Facilities :

CCAFS facilities include launch complexes, missile assembly buildings, and all other elements essential to the assembly, prelaunch, launch, and postlaunch operations of test vehicles. Trident basin and other military port facilities at Port Canaveral support the U.S. Navy Fleet ballistic missile ship, submarine operations, and the range support ship. The Naval Ordnance Test Unit, which manages Navy testing on ETR, is located at CCAFS.

Precision tracking radars are located at Cape Canaveral, Merritt Island, and PAFB and Grand Bahama, Antigua, and Ascension Islands. Radars are capable of either beacon or echo tracking, providing real-time data to the CCAFS computer. Scanning radars at CCAFS provide aircraft and ship tracking and control. Shipborne radars

provide midcourse and terminal coverage in the broad ocean areas.

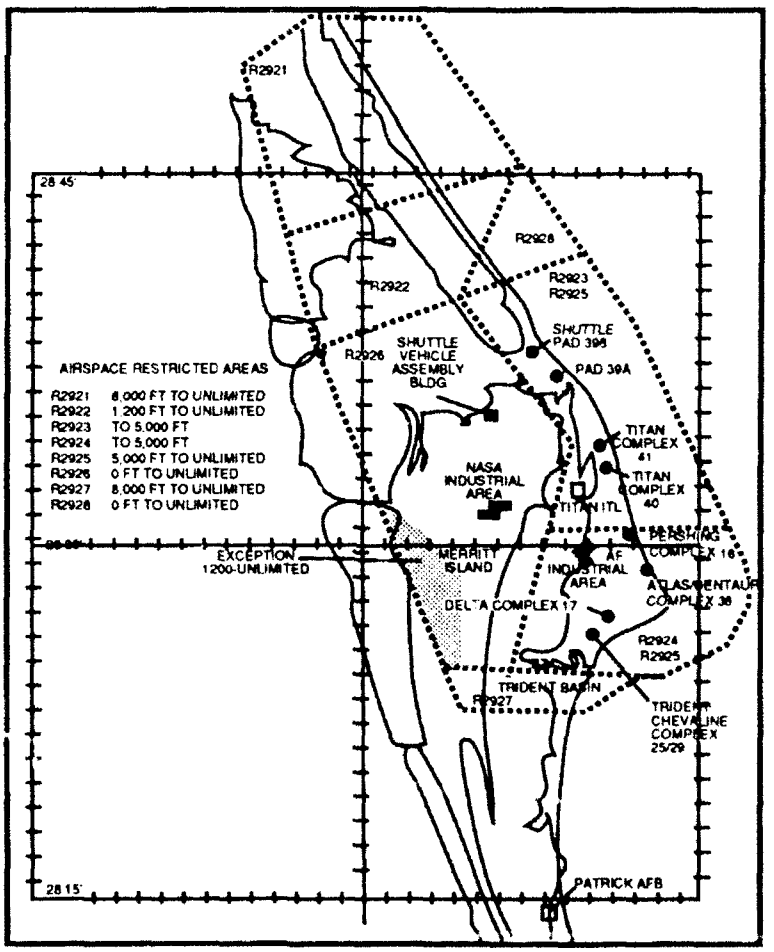
Metric optics capability is available at CCAFS and the Ascension Islands. These systems include precision theodolites, ballistic cameras, and long-range large aperture telescopes. Photo processing facilities are located at PAFB and KSC.

Missile Impact Location Systems (MILS) provide the primary source of impact data for inert and instrumented reentry bodies. The two systems are the (1) target array (or Pentagon) and (2) Sonobuoy MILS (SMILS). Target arrays of bottom-mounted hydrophones are located near Antigua and Ascension Islands. SMILS arrays are located in the broad ocean area. SMILS consists of deep-ocean transponders deployed and surveyed by a range ship and sonobuoys deployed at the time of launch by Navy P-3C aircraft.

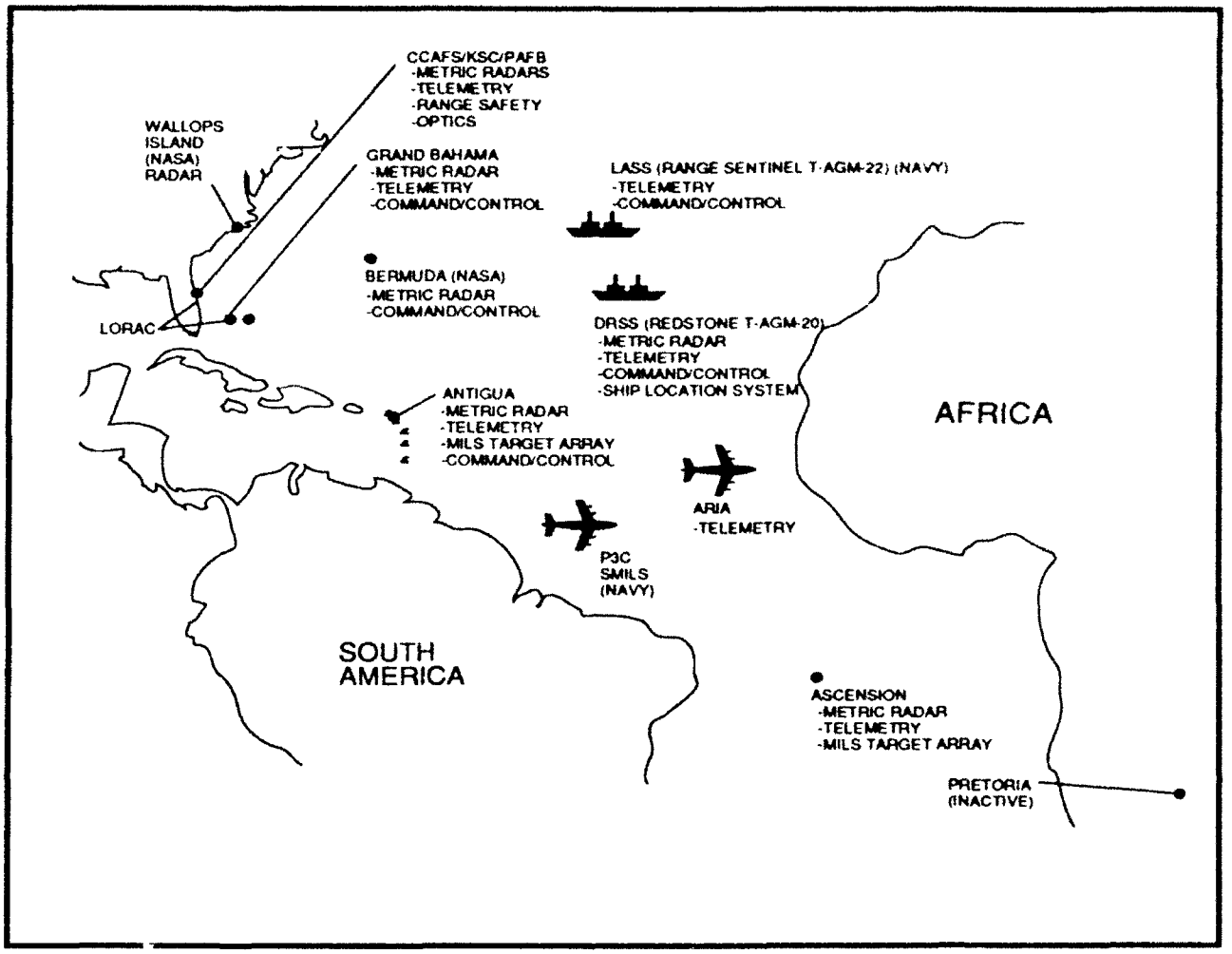
ETR telemetry support consists of land-based stations at Merritt, Grand Bahama, Antigua, and Ascension Islands and a shipboard station aboard the USNS Redstone. Telemetry aircraft support is provided by C-135 aircraft from Wright-Patterson AFB. Real-time data is available at CCAFS through subcable communications to Antigua Island and through satellite from Ascension Island. Telemetry doppler data capability for metric measurements exists at each downrange site except for Ascension Island.

Resources :

The instrumentation ship, USNS Redstone, can collect telemetry and range safety data on up to four missiles simultaneously. Its primary safety system for fleet ballistic missile operational tests is the flight test support system, which provides a multistation metric solution aboard the ship using data from a series of remote range stations.



ESMC Launch, Base, Industrial, and Restricted Areas



Eastern Test Range

Wideband communication, in the form of submarine cable, high frequency (HF) radio, and satellite link, is provided for retransmission of flight vehicle test data to the range control center at Cape Canaveral in real-time or near real-time from remote stations.

A computer center provides flight safety, weather, scheduling, and instrumentation target designation data support in real-time for each missile and space launch.

TYPICAL PROJECTS SUPPORTED

Atlas Centaur
Delta
Titan 34D
Pershing Follow on Testing
Space Transportation System (Space Shuttle)
Trident C-4
Poseidon C-3
Chevaline
Short Range Attack Missile
Penguin
Ariane

POINT OF CONTACT

ESMC/CC
Patrick AFB, FL 32925

Telephone:
AUTOVON: 854-4001
Commercial: (305) 494-4001

U.S.A.

TACTICAL FIGHTER WEAPONS CENTER (TFWC)

MISSION

Provide an operationally oriented, combat-like range facility where multiple air and ground participants can accomplish integrated air-to-air and air-to-ground training and T&E missions.

LOCATION

Nellis Air Force Base, 8 miles northeast of Las Vegas, Nevada.

CAPABILITIES

Topography :

The range complex covers approximately 6,000 square miles over desert terrain, with north-south mountain ranges separated by valleys and dry lakebeds. Elevations of the area vary from 2,500 feet to 10,000 feet mean sea level. Dry climate results in excellent flight conditions year-round.

Training for single sorties to joint exercises of several hundred aircraft can be accommodated.

Typical TFWC Weapon Tests

Ranges :

North Ranges. Two electronic combat (EC) areas (Tonopah EC Range and Tolicha Peak EC Range) provide a realistic enemy radar environment for aircrew training.

Range 71. Located in the northwest corner of R-4807. This tactical range consists of nuclear bombing circles, simulated missile sites, a convoy, an airfield, an industrial area, and a forward edge of the battle area. Live ordnance, except cluster bomb units (CBU), is authorized on target 74-10. All other targets are for training and inert ordnance, flares, rockets, and gun ammunition.

Range 75. Unmanned range consisting of missile sites and a convoy located in the central portion of R-4807. Training and inert ordnance and live ordnance (except for CBU munitions) are authorized.

Range 76. Located in the southwestern portion of R-4807 with airfields, missile site, industrial areas, railroad, railroad tunnel, convoys, and forward-edge-of-the-battle-area arrays. Training and inert ordnance is allowed on all targets. Live ordnance is allowed on certain targets as defined in local guidance.

South Ranges. Provide for air-to-air and air-to-ground munitions delivery, air-to-air combat maneuvering (including air combat maneuvering instrumentation), and realistic ground target simulation.

Range 61. Located in the northwest corner of R-4806. The single target is a simulated ICBM site located on the eastern side of the range.

Range 62. Located on the east side of R-4806. The majority of the targets are located in and around Dogbone Lake. The targets include nuclear bomb circles and tactical targets consisting of an airfield, supply area, antiaircraft artillery, convoys, and a surface-to-air missile site.

Range 64/64A. Located in the western side of R-4806. Training and inert and live ordnance, except for CBU munitions, are authorized on all targets on Range 64.

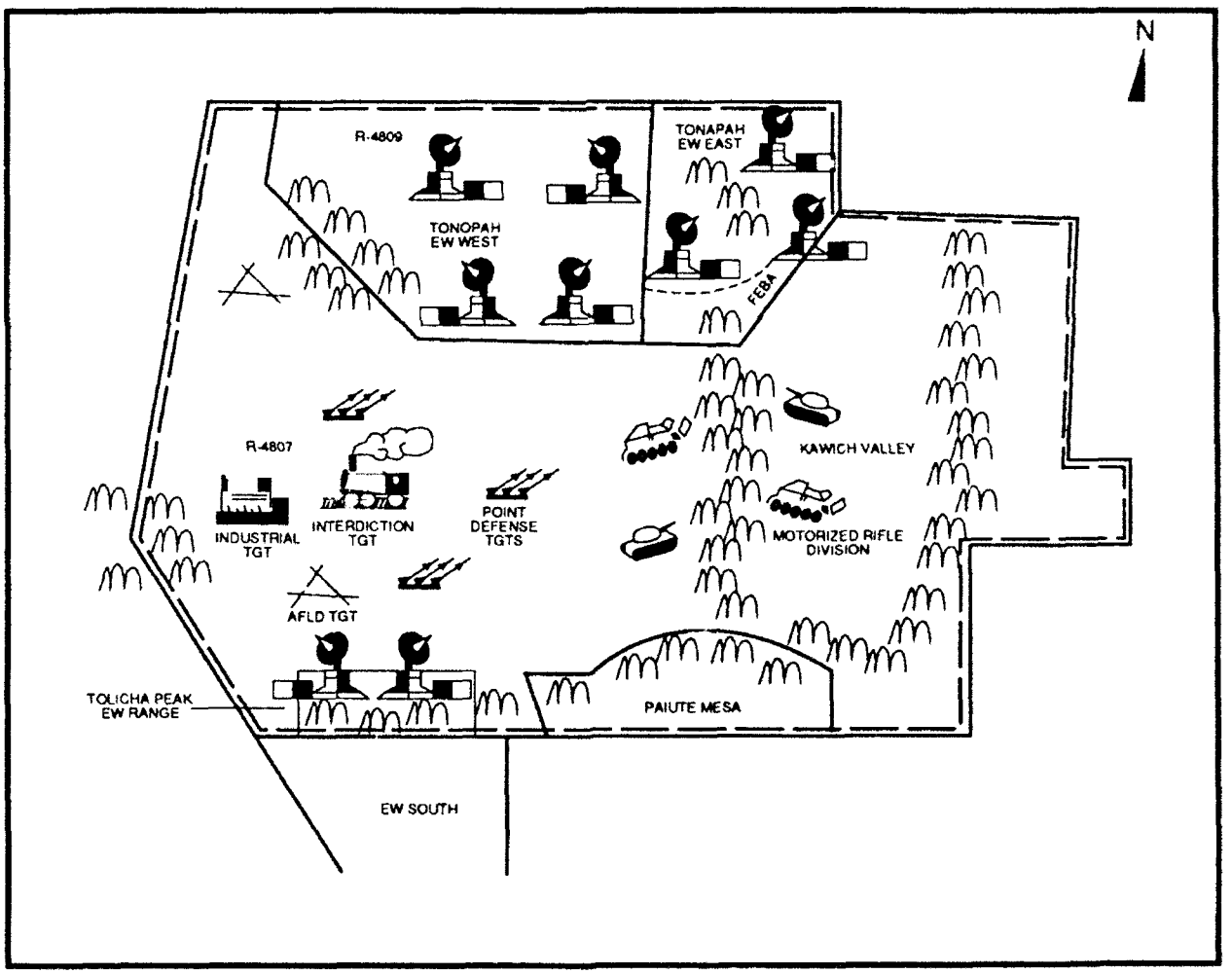
Dart East. Located within the boundaries of Ranges 61 and 62. The range is 9 nautical miles wide and 27 nautical miles long; the east side is marked at the south and north ends with diamond-shaped figures bladed on the ground. Gun ordnance, training projectile (TP), and training projectile tracer (TPT) are the only ordnance authorized.

Dart West. Located within the boundaries of Ranges 64 and 65. The range is 11 nautical miles wide and 20 nautical miles long. The east side is marked at the south and north ends by diamond-shaped figures bladed on the ground. Only gun ordnance, TP, and TPT are authorized.

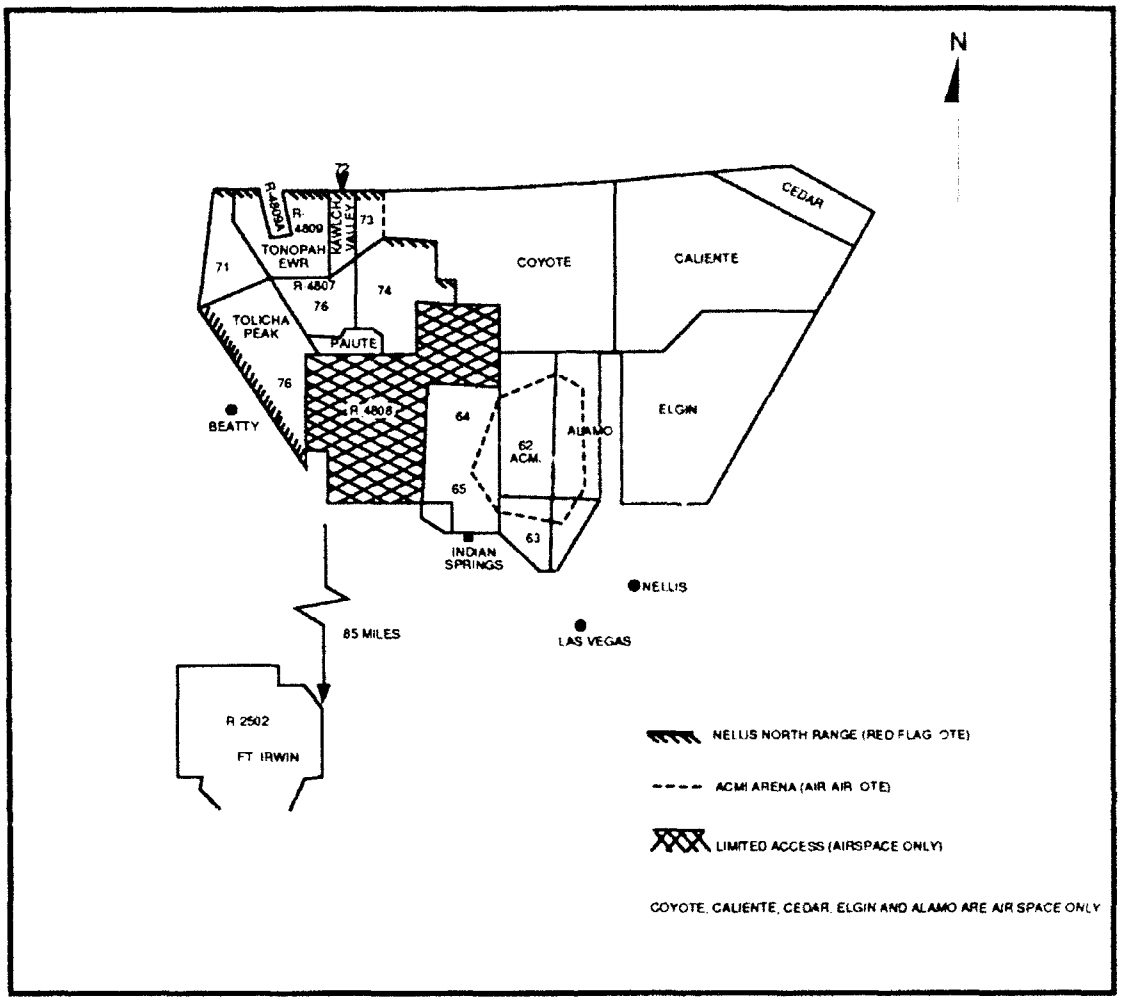
Facilities :

Air Combat Maneuvering Instrumentation (ACMI). The ACMI is a computerized tracking and monitoring system used for air-to-air testing, training, and tactics development. The ACMI areas overlay most of R-4806 and Alamo Air Traffic Control Assigned Airspace Areas.

Air-to-ground UHF communications are available to both EW ranges, the OT&E range, and the bombing and gunnery range.



TFWC NORTH RANGE



TFWC Range Complex

Available instrumentation and test equipment includes a television ordnance scoring system to determine impact and miss-distance for bomb drops; radars for target acquisition and laser target designators; optical equipment (cinetheodolites, tracking cameras, tracked telescope, and motion picture and still photography); and a variety of range targets.

A range control center provides real-time test control, air traffic management, and range data management.

NOTE: No airspace within the range complex will be overflown unless scheduled through the Range Group Scheduling Branch (AUTOVON 682-5143).

TYPICAL PROJECTS SUPPORTED

Aircraft: F-15, F-5, A-10, F-16, F-4, T-38, and A-7.

Training: Transition, Functional Check Flights, Air Combat, Electronic Combat, and Aerobatics.
Other: Operational Test and Evaluation (OT&E), Red Flag, EWCAS, AIMVAL/ACEVAL, ALCM, GLCM, and Gallant Eagle.

POINT OF CONTACT

Current Capabilities	Future Capabilities
554 RG/EN	554 RG/XD
Nellis AFB, NV 89191	Nellis AFB, NV 89191

Telephone:

AUTOVON:	682-3643
Commercial:	(702) 643-3637
Commercial:	(702) 643-3643

UTAH TEST AND TRAINING RANGE (UTTR)

MISSION

Provide range facilities for all phases of T&E of manned and unmanned aircraft systems and tactical training for air-to-air and air-to-ground weapon delivery for the Department of Defense and other government agencies.

LOCATION

The Utah Test and Training Range (UTTR) is contained within the Great Salt Lake Desert, approximately 70 miles west of Salt Lake City, Utah. UTTR management is the responsibility of the 6501st Range Squadron, located at Hill AFB, Utah. The 6501st Range Squadron is responsible to the 6545th Test Group and the AFFTC.

CAPABILITIES

Topgraphy : The UTTR consists of two large restricted ranges: the North Range, with an airspace approximately 23 by 49 miles, and the South Range, with airspace area approximately 50 by 68 miles. Restricted airspace extends from the surface to 58,000 feet on both ranges. Both North and South Ranges are bounded by military operating areas (MOAs).

The landspace is characterized by high-country deserts, undulating sand dunes, mountains rising abruptly from the desert floor, and rolling hills building up to mountain ranges. The DoD-owned landspace of 2,136 square nautical miles is surrounded by public domain and is not likely to be surrounded by population centers in the foreseeable future.

Ranges :

Eagle Range is a standard AFR 50-46 scorable air-to-ground range with two bomb circles, skip targets, two acoustical strafing panels, and various armored vehicles.

Helicopter Air-to-Ground Range is an unmanned range with various armored vehicles deployed to provide a realistic tactical scenario.

Wildcat and Baker's Strongpoint Ranges consist of simulated industrial complexes, bunkers and command post complexes, airfield (complete with surface-to-air missile sites), convoys, railroad yards, and aircraft in revetted positions. Wildcat Range has a real-time television optical scoring system.

Typical UTTR R&D Project Aircraft

Kitty Cat Range is a live ordnance drop area with three tracked vehicles that resemble an artillery fire support base.

Facilities :

The High Accuracy Multiple Object Tracking System (HAMOTS). a multilateration system tracks, records and displays the position of test vehicles at the UTTR. HAMOTS collects and time-space-position information (TSPI) of one or more targets for real-time display at the mission control center (MCC).

The UTTR radar network is composed of two precision tracking radars and a surveillance radar system. Both tracking radars are linked by microwave to the MCC at Hill AFB and displayed on plotboards. Radar information may be sent to Edwards AFB by microwave through the data acquisition and transmission system. Surveillance radar (AN/GPN12) is provided by the 299th Communication Squadron (Clover Control) of the Utah Air National Guard.

The UTTR has 12 cinetheodolites to provide TSPI on test vehicles. Six cinesextants and a full range of high-speed cameras provide documentary photography.

Two range telemetry acquisition stations and a ground station are located in the MCC at Hill AFB. A mobile telemetry acquisition system is available to be located anywhere on the Range Complex where there is a capability to interface with the microwave system.

Computer Facilities. The UTTR provides a full range of data processing, using four SEL 32/75, CYBER 73s located at Hill AFB and two CYBER 74s located at Edwards AFB.

Mission Control Center. The MCC serves as the UTTR primary operational control, communication, and data collection center. Located in Building 1274 at Hill AFB, one MCC can display real-time HAMOTS and radar TSPI data on a large screen display and plotboards, respectively. The telemetry can be recorded and displayed on stripcharts.

Resources :

Targets. The UTTR has a variety of target facilities to support both the operational and test communities.

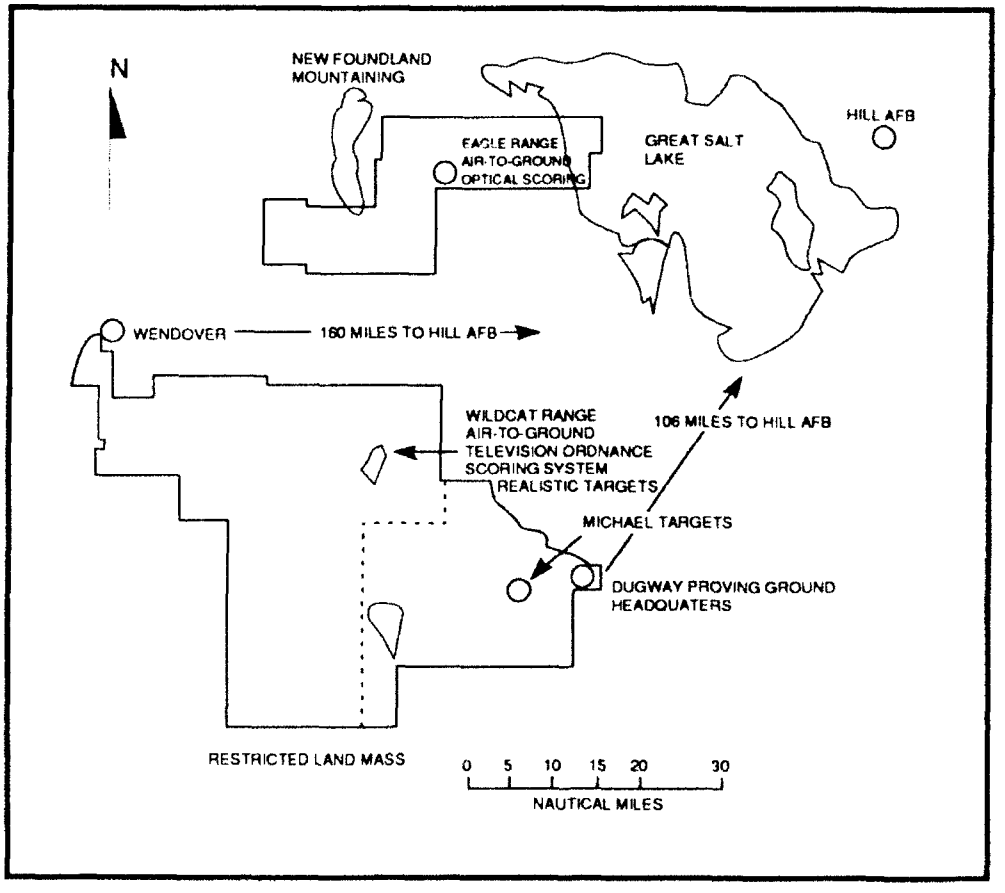
TYPICAL PROJECTS SUPPORTED

Cruise Missile Testing (ALCM, GLCM, SLCM), Maverick Missile Testing, Aircraft Systems Testing
Shelf Life Testing of Conventional Munitions
Full Spectrum of "Back Yard" Range Activity to Joint Training Exercises

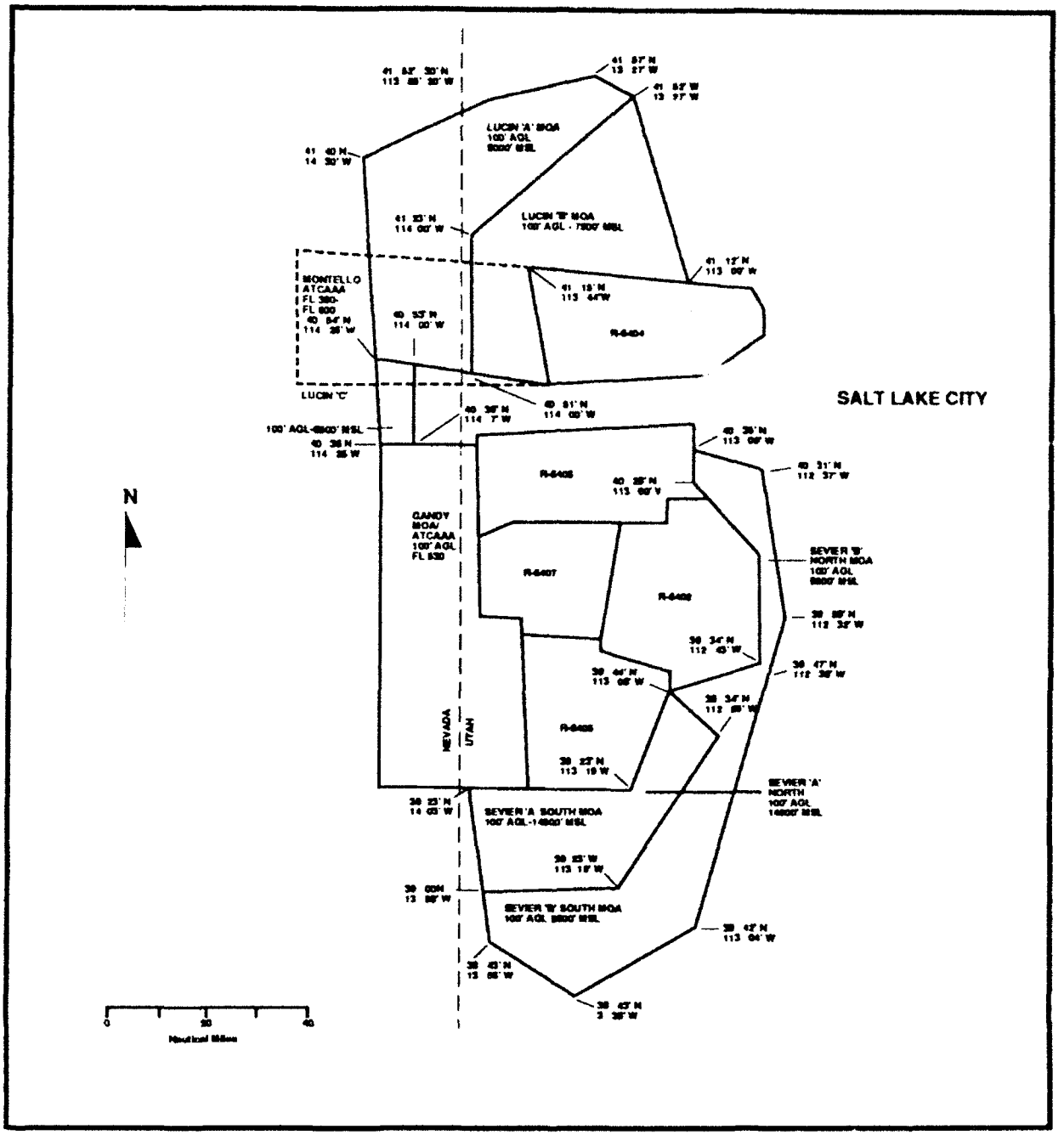
POINT OF CONTACT

6501 Range Squadron/TIRX
Hill AFB, UT 84056

Telephone:
AUTOVON: 458-7852
Commercial: (801) 777-7852



Utah Test & Training Range



Utah Test and Training Range Airspace

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WESTERN SPACE AND MISSILE CENTER (WSMC)

MISSION

Manage and operate the Western Test Range (WTR). The Western Space and Missile Center (WSMC) also manages space and missile field test operations and supports guided missile and aeronautical testing. The WSMC participates in the evaluation of test results and provides support and services to other DoD and non-DoD users.

LOCATION

The WSMC is located on Vandenberg AFB on the Central California coast 160 miles northwest of Los Angeles.

CAPABILITIES

Topography : Vandenberg AFB encompasses 98,400 acres and includes 35 miles of pristine Pacific coastline.

Test Support. The WSMC collects and processes trajectory, telemetry, and optical data for missile, space, aeronautical, and guided missile test operations. The WSMC also provides ground and flight safety, communications, meteorology, and data processing support. In conjunction with other ranges, principally the Pacific Missile Test Range, the Air Force Flight Test Center, and the Kwajalein Missile Range, the WTR give continuous instrumentation coverage over a broad portion of the western United States and the Pacific Ocean.

The WSMC can support space booster and ballistic missile launching across a wide range of launch azimuths (140-310 degrees). This allows direct polar orbit insertion of satellites without overflight of populated areas.

Ranges :

West Coast Offshore Operating Area (WCOOA). The WCOOA extends from San Diego to the Oregon border with possible extension into Alaska. Typically, testing is done within 150 miles of the coastline. The WCOOA is well suited for certain types of aeronautical tests.

Typical WSMC Projects

specifically long-range supersonic runs, sea-to-land transition tests, tests requiring turbulence-free atmosphere below 10,000 feet, tests requiring the aircraft to fly between sea level and 3,000 feet, and long-range weapons delivery. The Area Control Center accesses seven west coast air surveillance radars, plus one from El Paso, Texas, for space shuttle reentry support.

Facilities :

Major instrumentation systems operated include the following:

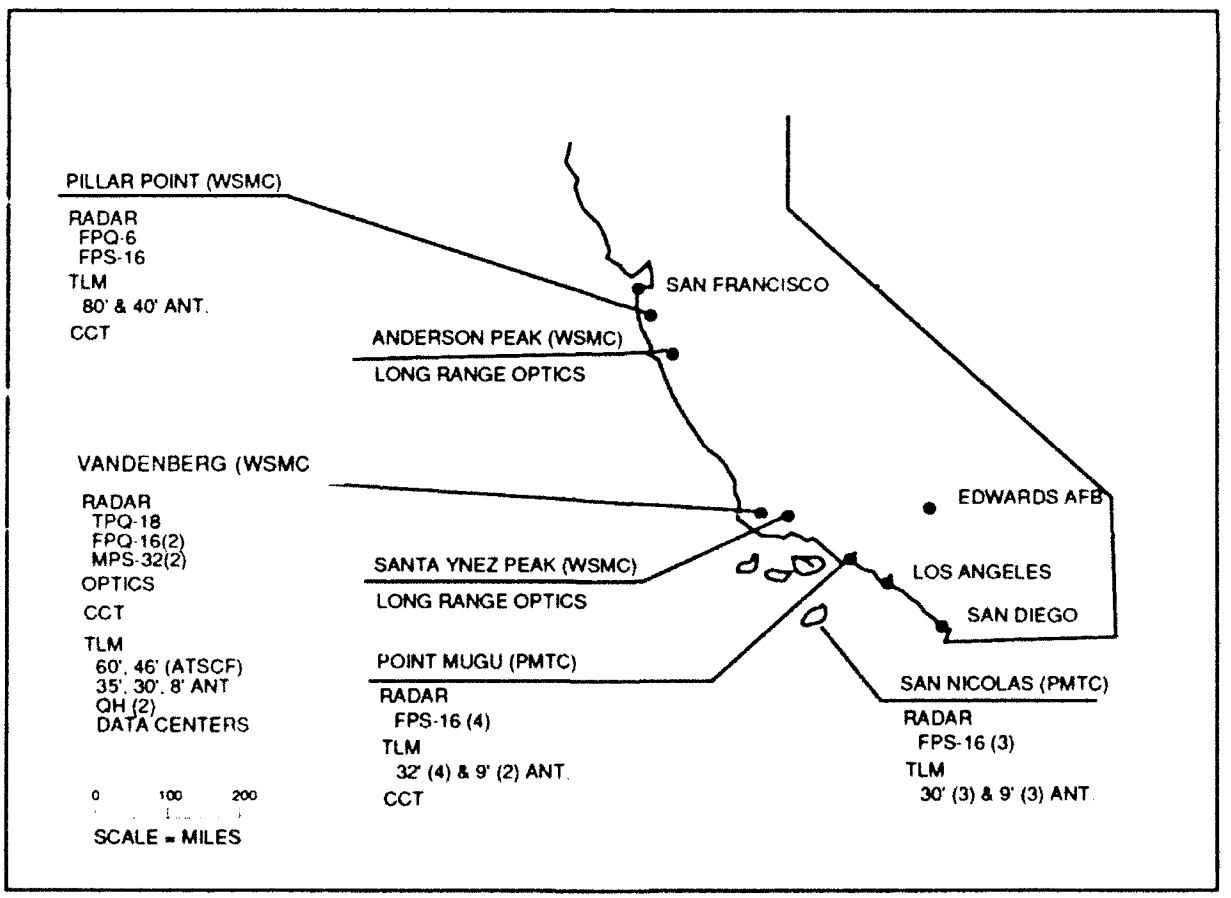
Metric Tracking. Precision radar tracking systems are situated at Vandenberg AFB and Pillar Point AFS, California, and Kaena Point, Hawaii. These radar systems provide trajectory data for range safety, flight analysis, aircraft vectoring, and weather balloon tracking. A variety of reduced metric data products is available.

Telemetry. Receiving and recording stations at Vandenberg AFB and Pillar Point AFS, with their associated antennas, acquire, record, and transmit telemetry data to the Vandenberg AFB data processing equipment through microwave data transmission systems. The display areas are capable of providing real-time computation, quick-look displays, and computer listings.

Optical Tracking. Three large-aperture optical instruments are situated on coastal mountains, one on Vandenberg, one 150 miles north (Anderson Peak), and one 30 miles southeast (Santa Ynez Peak), equipped with both film cameras and intensified video systems for recording ballistic missile launch data and space test events.

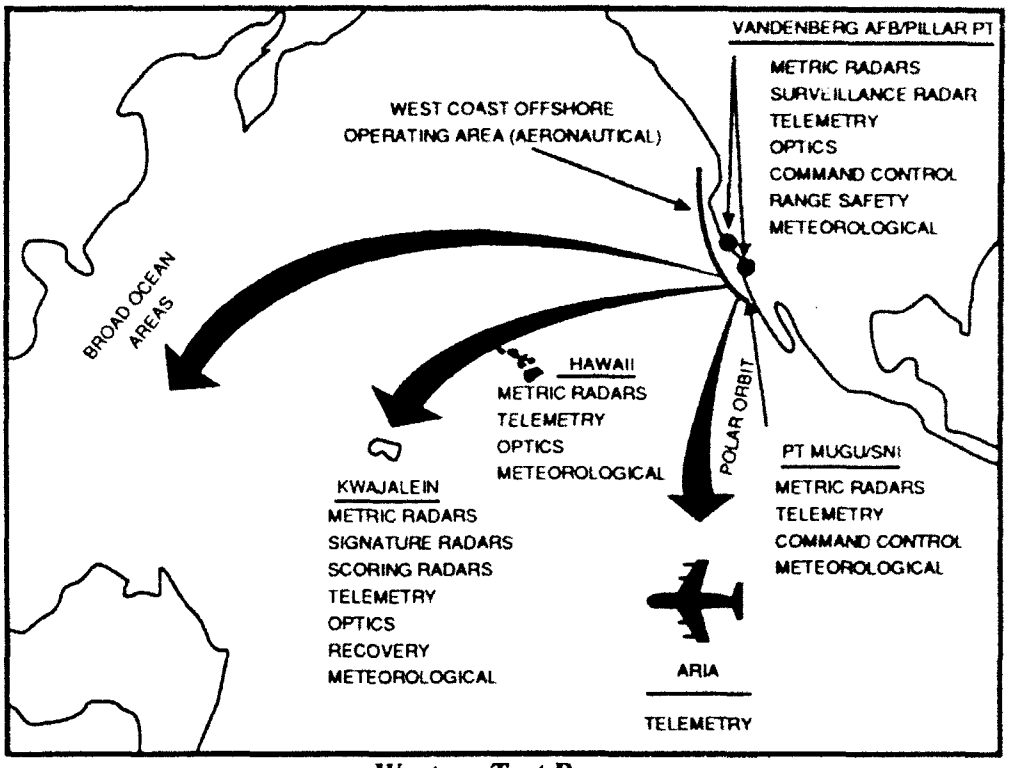
Command Control Transmitters (CCT). The WSMC has four CCT sites: two CCT sites at Vandenberg AFB, one at Pillar Point AFS near San Francisco, and one at Laguna Peak near Pt Mugu Naval Air Station, 100 miles southeast. The CCT sites transmit range safety commands to errant missiles or space boosters.

Midcourse Analysis. The WSMC operates an FPQ-14 radar at Kaena Point, Hawaii, that has been modified with



WSMC West Coast Locations

U.S.A.



Western Test Range

a directed tracking modification (DTM). The DTM reduces errors and allows extremely accurate midcourse tracking of missile launches from Vandenberg AFB. The Advanced Research Projects Agency (ARPA) Maui Observation Station, Mt. Halcakala, Maui, Hawaii, an optical site with long-range sensitive optics, is available along with telemetry and radar systems in Hawaii.

Reentry Analysis. The Army-operated complex instrumentation system at Kwajalein Atoll provides an extensive signature data-gathering capability for reentry vehicles that exists at no other site. Within the WTR, broad ocean area targets are being developed to provide reentry vehicle impact scoring telemetry and photography at varying ranges and azimuths from Vandenberg AFB in support of advanced ballistic missile testing.

Launch Facilities. Current missile launch facilities on Vandenberg AFB consist of Atlas, Titan III, Scout, Minuteman, and Thor complexes with attendant support systems. Soon to be operational will be M-X and Space Transportation System facilities.

TYPICAL PROJECTS SUPPORTED

The WSMC and the WTR support ballistic missile and space aeronautical programs and associated ground testing. Special project programs (nonlaunch) supported include electronic equipment development, satellite support, meteorological support, aircraft support, missile launcher ground tests, and drop tests. Examples of major programs supported are the following:

Minuteman I
Minuteman II and III
(SAC)Peacekeeper
Air-Launched Cruise Missile (ALCM)
B-52 IWS
Guided Missile Flight Test
Space Defense System
Space Transportation System
B-1B Flight Tests
NATO E3A Flight Test
Titan, Atlas, and Delta Scout Space Boosters

POINT OF CONTACT

Naval Weapons Center
Test and Evaluation Directorate
China Lake, CA 93555
Code: 061

Telephone:
AUTOVON: 276-9749
Commercial: (805) 866-9749